EXECUTIVE SUMMARY

LODGEPOLE PINE/MOUNTAIN PINE BEETLE SITUATION

UNITED STATES/CANADA, 1981

DRAFT

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OBJECTIVE

To review past and current mountain pine beetle outbreaks; discuss the state of knowledge concerning biology, ecology, and management of lodgepole pine stands and MPB populations; study management options and develop a joint U.S./Canada action strategy. For more complete detail and additional summary background information, the reader is referred to the "Proceedings of the Joint Canada-United States Workshop on Mountain Pine Beetle-Related Problems in Western North America," Canadian Forestry Service, Environment Canada, 1982 (BC-X-230).

THE PROBLEM

An indigenous organism, the mountain pine beetle is the prime insect affecting lodgepole pine in the Western United States, British Columbia, and Alberta. Its habitat is the 41 million forested acres (17 million hectares) in the Western United States, the 34 million (14 million hectares) in British Columbia, and the 6 million (3 million hectares) in Alberta having lodgepole pine as a significant component. It was not until this century that mountain pine beetle was recognized as a problem, when it began to interfere with man's use or management of the forest.

Since the early 1900's, infestations in various areas increased to epidemics in successive periods of 25-30 years. During the past 20 years, outbreaks have occurred from Utah through Wyoming, Idaho, Montana, and Washington to British Columbia and Alberta as well as the Blue Mountains and the Deschutes Plateau in Oregon. From chemical control of individual infested trees in the 1950's and 1960's, the emphasis has changed to silvicultural operations and prevention.

The mountain pine beetle can have appreciable impact on a number of forest resources. It often attacks trees in patches or contiguous areas, which may create harvesting chaos and affect even flow and sustained yield. In 1981 alone, 99 MMCF of lodgepole pine timber was lost in the Western United States to mountain pine beetle. Inadequate road access limits the ability to salvage the timber as well as rehabilitation efforts. The desirability of a forest for recreation and mountain property values are reduced considerably if a large number of trees are killed. Landowners adjacent to infested lands are threatened by beetle population buildup or wildfire spreading from beetle-killed trees. Large areas of heavy tree mortality may be detrimental to elk and deer as cover/opening relationships are changed.

Infested acres and trees killed during 1981 in the United States by States and in Canada by Provinces are shown in Appendix I and Appendix IV, respectively. Acres infested and amount of recent lodgepole pine mortality with projections through 1985 for each western State in the United States and for the Canadian Provinces of British Columbia and Alberta are shown in Appendix II and V, respectively. The chronological development of recent

major MPB infestations in lodgepole pine areas (green) in the United States and Canada are shown on maps in Appendix III and VI. (Infested areas are shown in red.) A recently developed joint U.S./Canada Action Plan showing specific tasks and accomplishment responsibility assignments for improving the handling of this problem is included in Appendix VII.

RESOURCES AFFECTED AND THREATENED

Timber

All unmanaged mature and overmature lodgepole pine stands are susceptible to mountain pine beetle attacks. Low and moderate hazard stands of younger age classes and smaller diameters are experiencing significant mortality when adjacent to epidemic infestations in high-hazard stands. Many stands are additionally infected with dwarf mistletoe, root rots, atropellis canker, western gall rust, stalactiform rust, and comandra rust. Where lodgepole pine is not the climax species, ponderosa pine, grand fir, white fir, Douglas-fir, western larch, and white and Engelmann spruce commonly are found where the lodgepole pine canopy is beginning to deteriorate. For the most part, infestation occurs in mature lodgepole pine stands which cannot be placed under management on a timely basis. Road access is usually too costly to be carried by the dead and dying timber, which should be immediately havested.

An example of the magnitude of this problem occurs in Montana and northern Idaho where there are an estimated 5.1 million acres (2.1 million hectares) of mature lodgepole pine stands that are highly susceptible to mountain pine beetle. Additional stands dominated by another species with up to 50 percent lodgepole pine are also very susceptible. The volume of the lodgepole pine type on commercial forest land in Montana and northern Idaho is about 19.5 billion board feet, roughly 5,200 board feet per acre, on 3,726,000 acres (1,508,500 hectares). Most of these acres are not planned for timber harvest until some time in the future. Consequently, if mountain pine beetle infestations continue to develop, spread, and intensify, impact on the timber resource will be quite significant.

Excluding areas that are salvage harvested, a large portion of commercial forest land will be understocked. Advanced regeneration in susceptible lodgepole pine stands is often sparse, clumpy, or nonexistent. Where advanced regeneration is present, it is often composed of climax species which are inherently slower growing and more difficult to manage. Much of this understocked area will not be accessed by roads, and if financing were available for restocking, lack of access would preclude or postpone artificial regeneration efforts. Natural regeneration will be much slower without fire and productivity will be reduced.

Watershed

Mountain pine beetle outbreaks affect watersheds to varying degrees, depending on the extent and intensity of the infestation. Water yield increases when significant tree mortality occurs. In eastern Oregon and

Washington, annual precipitation averages 20 to 40 inches per year. Many streams that supply the main source of flow for the lower drainage systems originate in the lodgepole pine type. An increase in water yield of as much as 30 percent is expected for 15 years after a beetle infestation collapses. Water yield should decline as new stands are established. An increase in flooding is not expected, but undesirable flow rates may occur.

Wildlife

Mountain pine beetle infestations will cause changes in wildlife species composition and distribution. The capacity of wildlife to adapt to changing environmental conditions varies. Specialized animals with narrow limits of adjustment may be adversely affected by infestations.

If the mountain pine beetle infestation results in a increased mosaic of live trees and forest openings, habitat diversity will increase to the benefit of many wildlife species, including economically important species such as deer and elk (big game). If the infestation creates extensive areas of dead trees, two negative effects to big game can result: (1) a deficiency of hiding and thermal cover, and (2) impediment of travel as stands deteriorate and fall down. Further detrimental effects can result to all wildlife if subsequent, intense wildfires burn extensive acreage. Large, intense burns often result in increased overland waterflow and erosion which is detrimental to aquatic ecosystems and dependent fisheries, both recreational and commercial.

A current example of negative effects on wildlife exists on the Hebgen Lake District of the Gallatin National Forest in Montana. Mountain pine beetle infestations have stimulated extensive salvage harvest on both private and National Forest lands. The result is loss of thermal and hiding cover for elk and grizzly bears. Without harvest, stand deterioration would cause other wildlife problems as described above. A similar scenario is now occurring on National Park Service, National Forest, State and private lands in the North Fork Flathead River, also in Montana.

Range

Both forage quality and production under closed stands of mature lodgepole pine are poor. The only benefit lodgepole contributes towards livestock is shade, but in certain situations where shade is limited, this can become a critical factor. Infestations cause open stands, which allow the appropriate interactions to take place that increase forage. Examples on both the Gallatin and Deerlodge National Forests in Montana show increased production and utilization under an open canopy and decreased utilization when either down timber hampers access or regeneration reduces forage production. Logging and cleanup of down timber benefits livestock.

Recreation

Many popular recreation areas have been infested by mountain pine beetles. Effects vary from impacts on scenic vistas as trees turn brown and die to heavy tree mortality in developed sites such as campgrounds. At some popular campgrounds, insecticides have been successfully used to preserve the most important tree cover. At others, sites have been abandoned or moved because of excessive tree kill.

Following an infestation, the scenery changes as trees and stands are cut or die. In the Front Range of Colorado, it is estimated that full recovery from insect damage should occur 60-65 years after mountain pine beetle attack. Over a 62-year growth cycle, the present value estimates of recreation would be reduced by 40 to 60 percent.

Colorado mountain property values decrease as the number of trees decrease from 140 trees per acre. At 140 trees, an improved lot in a recent study was valued at about $7,645 per acre. At 100, 50 to 10 trees per acre, the values drop to $7,569, $6,717, and $5,460 per acre, repectively.

In the general forest area, impacts on scenery are temporary. New stands will eventually replace the killed trees, which at times take on an increasingly attractive appearance to visitors. During the process of stand replacement, larger numbers of diverse species of wildlife will likely add to the visitor's experience. In many instances, killed stands of pine have become major areas for wood gathering for home heating.

Options available to recreation managers include: (1) removing dead, infested, or high-risk trees from areas of visitor concentration such as developed sites, (2) allowing the beetle attack to run its course and letting the forest renew itself, (3) spraying limited high-value areas with protective insecticides, and (4) maintaining healthy vigorous stands of trees of diverse species through such practices as planting, thinning, fertilizing, and harvesting.

Fire Considerations

A large proportion of the western forests regenerated following fire. Following a mountain pine beetle epidemic, the buildup of fuel greatly increases the risk of wildfire.

Currently, mountain pine beetle infestations are building enormous fuel beds that will, in time, burn unless fuel treatment occurs. The Sleeping Child Fire of 1961 in Montana which caused an enormous amount of resource loss occurred about 30 years following a large-scale outbreak. Protection capabilities are geared to normal fire and fuel situations. When fuel beds such as those now being created by the mountain pine beetle occur, protection forces are taxed. Either logging or other treatment is needed to abate the hazard. The North Fork of the Flathead River, including the west side of Glacier National Park, the Gallatin River Canyon, Yellowstone National Park, and the northern part of the Kootenai National Forest in Montana are examples of vast fuel beds that have been created recently by mountain pine beetle.

At the present time, burning conditions are classed as moderate in most of the lodgepole pine type. Fire incidence and burned acreage in the past 10 years have been low. However, as infestations intensify, an increase in the incidence of large, intense fires is inevitable in these stands. In some areas, killed trees outside designated wilderness areas and on slopes too steep for commercial harvesting are being utilized as fuelwood, which may reduce fire hazard in specific areas.

Although fire will reduce lodgepole pine fuel, it will also likely spread into other timber stands. With fuels of this magnitude, large areas are likely to be burned, causing watershed, soil, wildlife, and other associated impacts.

Prescribed burning by itself offers a challenging and difficult opportunity to reduce the conflagration potential of mountain pine beetle-caused mortality in lodgepole pine stands outside wilderness. Fire occurrence is initiated naturally in these heavy fuel loadings of down and standing dead lodgepole pine trees following infrequent periods of prolonged drought. Intentionally burning these stands under the dry conditions required to sustain fire spread poses a significant risk to successful containment. In areas being managed for timber output, timber harvest coupled with prescribed burning can be a feasible solution in regulating future mountain pine beetle epidemics by developing age class diversity.

Wilderness

The definition of wilderness in the United States Wilderness Act of 1964 makes it clear that the intent of Congress was to allow the forces of nature to shape the character of wilderness areas with minimal influences of man. Therefore, infestations are usually allowed to run their course, killing most of the larger, more desirable trees in entire stands of lodgepole pine. In the absence of fire, replacement of seral stands of lodgepole pine by Douglas-fir at lower elevations, and subalpine fir and Engelmann spruce at higher elevations and drainage bottoms, can be expected to occur naturally. These stands can subsequently become highly susceptible to infestations of spruce, Douglas-fir, and fir engraver beetles. If fire occurs prior to completion of succession, some stands will regenerate to lodgepole pine, and without management, another cycle of mountain pine beetle infestations will occur.

Based on current knowledge, it appears partial protection can be attained by sanitation salvage, clearcutting, and stocking regulation (removal of lodgepole 8 inches (20 cm) d.b.h. and larger, or thinning from below). Where this is done in areas adjacent to wilderness or other similar nontimber producing areas, it may be necessary to directly control intense outbreaks in an adjacent buffer strip within the wilderness or similar area. One conceivable alternative for management of lodgepole pine within wilderness areas may be a fire management program of prescribed burning in lodgepole pine forests. Otherwise, it may be necessary to forgo management investments in lodgepole pine stands adjacent to wilderness or similar areas.

MOUNTAIN PINE BEETLE BIOLOGY AND FACTORS AFFECTING OUTBREAKS

Much of the general biology and ecology of the mountain pine beetle is known. Beetles emerge from the bark in July and August to infest living trees. The beetles carry a complex of fungi that disrupt the tree's water transport system, thus aiding in killing trees. Galleries are constructed in the inner bark and eggs are laid along each side of the gallery. Larvae hatch from the eggs and feed in the inner bark. They are inactive during winter, then resume feeding in the spring and complete development by early summer. The larvae transform to adults by July, completing the usual 1-year life cycle.

Several important factors contribute to outbreaks in unmanaged lodgepole pine stands; some variation can be expected in managed stands. Climate where stands are located has an overriding effect on whether beetle outbreaks can develop. Beetle outbreaks usually start in lodgepole pine stands at low elevations where temperatures are optimum for the beetle to complete its life cycle in 1 year. From these beginnings, the beetles move up slope, killing fewer trees as elevation increases because the beetle cannot complete its life cycle in a single year and suffers heavy mortality during the longer developmental period.

Tree diameter and age also are important. Outbreaks seldom develop in lodgepole stands that average less than 8 inches (20 cm) in diameter at breast height (d.b.h.). Most unmanaged stands averaging 8 inches (20 cm) or larger d.b.h. usually contain some trees up to 16 inches (40 cm) d.b.h. Beetle survival is greater in larger than in smaller trees. For example, the average number of beetles emerging from a tree 8 to 9 inches (20 to 23 cm) d.b.h. is only 300 compared to over 18,000 from a tree 18 inches (46 cm) d.b.h. Stands less than 60 years old seldom support an outbreak. This is because the inner bark of young trees is usually more resinous than that of older trees. Such trees, even though attacked and killed, dry quickly and produce only a few new adult beetles.

The inner bark is the food of mountain pine beetle larvae. Thick inner bark is related to good tree growth and, in trees of the same age, is usually thicker in larger than in smaller trees. The number of beetles emerging per square foot of bark ranges from about 20 for inner bark 0.06 inch (15 mm) thick to over 140 beetles for inner bark 0.18 inch (46 mm) thick. Mountain pine beetle infestations decline after most large diameter trees are killed.

Biological factors, including many predacious and parasitic insects and birds, have been studied in a number of geographic areas. None of these regulated a mountain pine beetle infestation before heavy tree losses occurred. Mountain pine beetle outbreaks are strongly related to tree and stand factors, thus suggesting silvicultural practices as the principal means of preventing or minimizing outbreaks.

MANAGEMENT

The land manager has an array of alternative actions which can be taken to prevent or minimize epidemics, or possibly suppress them once they occur. Epidemics are associated with unmanaged mature and overmature stands that are declining in vigor. The management alternative selected will be determined by the management objectives for the affected area and the intensity of the outbreak. The most satisfactory approach to reducing losses from mountain pine beetle in lodgepole pine forests is through preventive management. Effective hazard rating systems are available for most lodgepole pine areas of the United States and Canada. Extent of mortality can be accurately predicted for many lodgepole pine stands. Losses can be reduced by directing harvesting or other management action priorities to the highest risk stands first.

Management strategies may be divided into (1) long-range prevention through silvicultural practices prior to and during an outbreak, and (2) suppression activities such as felling and burning, chemical treatments, and sanitation/salvage operations during an infestation.

The choice of strategies should be based on management objectives, silvicultural considerations, resource values, and other pest problems. Silvicultural practices for pure, even-aged lodgepole pine stands include: (1) stocking control in young stands, (2) organized clearcutting to create age, size, and species mosaics from mature stands, (3) salvage cutting to mitigate losses in stands under attack, with full consideration for the protection of other resource values, and (4) sanitation cutting of preferred large diameter infested trees in high-risk stands to reduce the mortality rate. Additional silvicultural practices for pure, uneven-aged lodgepole pine and mixed species stands include: (1) clearcutting in mature stands with a significant component of large lodgepole in the overstory, and (2) stocking control with species discrimination in immature, mixed species stands.

Selective harvest of susceptible larger, older trees is recommended in pure stands containing from two to several age classes and in uneven-aged, mixed species stands with overmature lodgepole overstory with a mixture of one or more climax species. Species discrimination against lodgepole pine is a valid practice in regulated forests only if the residual stand is of sufficient vigor and stocking to maintain stand growth near the capacity of the site. Partial cutting (basal area, diameter limit, or thinning from below) is justified in pure and mixed species stands just coming under attack to delay or prevent mortality in the treated and in adjacent, extensive, susceptible stands. Partial cutting is recommended for stands that (1) have low infestation levels, (2) have relatively high vigor, (3) have some nonhost species, (4) have high stocking levels so the residual stand is manageable, and (5) are in drainages where extensive clearcutting has occurred and regeneration of cut areas is required for cover, watershed, protection of riparian zones, and visual concerns (e.g., road rights-of-way, campgrounds, view areas) before additional areas can be clearcut. Partial cutting is not recommended on terrain too steep for conventional logging or in areas with high windthrow hazard.

Suppression strategies, designed to minimize losses during an outbreak, are difficult to execute and evaluate, and serve only as holding measures to allow the land manager to salvage some of the investment. The most common suppression strategy employed is sanitation/salvage logging which is a treatment method that can reduce losses during outbreaks. It provides an opportunity to harvest green timber and remove infested trees, thus slowing the progress of the infestation in susceptible or threatened stands. Accelerating the harvest schedule in an outbreak area provides the same opportunities as sanitation/salvage operations. Other measures which can be utilized in managing localized outbreaks in high-value stands are felling and burning, prescribed burning, and chemically treating infested logs with lindane or ethylene dibromide. 1/ However, unless the underlying forest conditions which have contributed to the high stand susceptibility are changed, suppression tactics will not reduce or prevent mortality--they may only temporarily slow the progress of the outbreak.

In residential areas, summer home sites, and campgrounds, high-value trees can be protected by treatment every 1 to 2 years with Sevimol®. Although this treatment is effective during an outbreak, it does not change the susceptible condition of the trees, and treatment must be continued for the duration of the outbreak.

RECENT ACTIONS TAKEN TO DATE

Dissemination of information to landowners

Providing the land manager with information on how to predict the probability, prevent, and/or suppress mountain pine beetle outbreaks and how to assess the economic impact of an infestation is critical to implementing sound forest management practices designed to minimize losses to the beetle. Numerous information approaches, ranging from extension brochures to field demonstration areas, have been used to transfer "state-of-the-art" technology to the land manager.

In central Oregon, for example, the USDA Forest Service, Oregon State Department of Forestry, and USDI Bureau of Land Management collaborated in the development of a pamphlet ("Condition Red") that covers the causes of mountain pine beetle outbreaks in pine forests, the mountain pine beetle life cycle, and various management options available to reduce wood loss and effects on other forest resources. It also lists addresses of State and Federal offices where more information and assistance can be obtained for landowners. The local media (newspapers, radio, TV) was also used extensively to inform the public of the current outbreak in central Oregon and what can be done about it.

1/ Both chemicals registered in the United States for application only to trees that have been cut and placed on the ground.

Field demonstration areas have been established in Montana, Oregon, Idaho, and Utah to show forest managers silvicultural methods that can be used to prevent or minimize mountain pine beetle losses. In the United States, these demonstration areas are usually part of the regular timber programs on a National Forest and provide an excellent opportunity for rapid technology transfer.

Other avenues for disseminating information include news releases, technical and public meetings, and published literature concerning recent successful approaches in minimizing mountain pine beetle impacts. The USDA Forest Service Intermountain Forest and Range Experiment Station and the Canadian Forestry Service have published management guidelines for reducing losses to mountain pine beetle in lodgepole pine forests. These publications are available to all landowners and stress risk rating and silvicultural practices to prevent losses in lodgepole stands. Pest Action Council meetings with associated field trips to demonstration areas have served to accelerate technology transfer by bringing land managers and research scientists together to discuss the beetle problem.

In British Columbia, special and annual reports of the Forest Insect and Disease Survey have, since 1968, recorded the expanding outbreaks in the Elk River and other areas of the East Kootenays. The Canadian Forestry Service continues to participate in the B.C. Forest Pest Review Committee and in regional groups such as the East Kootenay Insect and Disease Control Committee. During 1981, six major workshops on mountain pine beetle biology and control strategies were held and frequent on-site inspections, field trips, and many personal contacts have been made by research staff and the Forest Insect and Disease Survey Rangers.

A special position paper on mountain pine beetle problems with special reference to the Rocky Mountain Parks Region was recently published in Canada.

The British Columbia Ministry of Forests continues to be very active in informing the public and management agencies about mountain pine beetle in the Province. The Ministry of Forests sponsors the B.C. Forest Pest Review Committee as well as Regional pest committees. Two color films and a slide-tape package have been made showing the damage and control methods for pine beetle. Ministry staff distribute information handouts produced by both Ministry of Forests and other agencies. As well, Headquarters and Regional Information Officers maintain close contact with the various media to insure adequate public awareness. Formal and informal training sessions are often held, and Headquarters and Regions have produced or are producing operational management guidelines.

In Alberta, the Canadian Forestry Service's Forest Insect and Disease Survey (FIDS) has monitored and mapped infestations since the start of the outbreak in 1977; findings have been summarized in Annual Reports and distributed to forest management agencies. Canadian research scientists and FIDS personnel participated in numerous meetings with the general public, special interest groups, technical groups, and news media. They have also participated in training sessions and information exchange with the Alberta Forest Service, Alberta Parks, and Parks Canada and assembled information for high-value tree protection in Alberta and Saskatchewan.

Since 1980, the Alberta Forest Service has been well aware of the interest and attention generated by the mountain pine beetle problems. In order to inform the land managers and the public, a series of meetings were held which generally described the problem and what the Forest Service was proposing to initiate. A media meeting attended by TV, radio, and newspaper was highly successful in presenting the problems and generating public awareness. Besides these meetings, slide-tape programs and pamphlets were developed. At annual summer fairs in affected areas, along with major city fairs, the slide-tape programs were shown and pamphlets were handed out to the public. In February 1981, the Alberta Forest Service jointly sponsored an international symposium on the beetles with the Canadian Institute of Forestry. Participants from both the United States and Canada representing various government agencies and private industry presented papers. The symposium papers have been published and are available from the Alberta Forest Service.

Direct control action

Since 1980, Alberta has spent almost $3.7 million in support of a beetle control action program. In 1979, the southwest corner of the Province adjacent to British Columbia and Waterton National Parks became very heavily infested with the mountain pine beetle. There were signs at that time of a northerly movement of the beetle. Considering the very high value of all the lodgepole pine stands along the east slope of the Rockies, a decision was made to attempt to limit the spread. As no effective chemical or biological treatments were available in Canada, the procedure used was to fall infested trees and either salvage them for lumber or burn the logs prior to beetle emergence. Most of the logs were salvaged. The control program appears to be a success. Alberta has thus far apparently arrested the northerly spread, and the number of recent beetle-attacked trees within the control zone has declined.

To promote liaison and discussion of proposed control actions in Canada, an Interagency Committee on Mountain Pine Beetle was created with representatives from the Alberta and British Columbia Forest Services, Parks Canada, and the Canadian Forestry Service.

Special access road development

Lack of roads in many beetle-infested stands has impeded lodgepole pine management programs in the United States. Significant investments have been made and additional investments are needed to provide the access necessary for road construction and reconstruction in support of salvage and green timber sales related to mountain pine beetle infestations in the Western States.

In Montana, direct investments on National Forest lands between 1979 and 1981 have been as follows:

National Forest	Miles	M Dollars
Flathead	101	$3,705
Gallatin	7	579
Kootenai	57	1,289
Total	165	$5,573

A continuing program in Montana is planned for 1982 through 1984 as follows:

Year	M Dollars
1982	$ 268,000
1983	1,224,000
1984	79,000

The Targhee National Forest, Idaho, began a $7-million preroading program in 1976 in support of the Forest salvage effort. Road construction and reconstruction investments are summarized below:

Year	Miles	M Dollars
1976	39	$1,040
1977	49	711
1978	131	2,631
1979	43	1,038
1980	25	466
1981	27	411
Total	314	$6,297

Approximately 300 miles of construction and reconstruction have been completed to date, allowing harvest of large volumes of salvage material in a relatively short time.

In the States of Oregon and Washington, the following investments are scheduled for the period 1982 through 1985 towards construction or reconstruction of roads in support of rehabilitating lodgepole pine stands on National Forest stands:

Year	M Dollars
1982	$ 114
1983	1,700
1984	1,200
1985	1,100

The British Columbia Ministry of Forests has allocated $11.4 million during 1981-82 for improved access construction for bark beetle control programs, and the Alberta Forest Service has expended $2.7 million in direct control efforts.

In Alberta, a direct access development program has not been included in the beetle control program. However, concessions in the form of stumpage subsidization have been given to operators for salvaging beetle-killed trees. In British Columbia for the past few years, licensees in mountain pine beetle-affected areas have been directed, as much as possible, into active pine beetle infestations for sanitation harvesting. The roads built during this activity have provided access into large tracts of infested and uninfested pine stands. Under the Emergency Bark Beetle Control Program, many roads were upgraded, extended, or built to provide access to priority sanitation harvest areas rather than into salvage areas. Access was also improved into currently uninfested areas with susceptible type so that high hazard stands could be removed prior to being infested and so that fast action could be taken on new incipient infestations in these areas.

Salvage efforts to date in terms of volumes sold by years

A significant amount of lodgepole pine volume has been sold in the United States since 1976 after markets were developed and sawmills were adapted to efficiently manufacture small diameter logs. As an example, more than 2.7 billion board feet of salvage and green lodgepole pine sawlogs has been sold from National Forest lands in seven Western States for the period 1976 through 1981 as follows:

Lodgepole pine volume (MMBF) sold from National Forest lands

Year	Washington	Oregon	Idaho	Montana	Wyoming	Colorado	Utah	Total
1976	11.9	82.5	54.1	103.2	70.8	21.8	11.5	355.8
1977	10.4	152.7	111.3	111.2	31.5	17.9	23.7	458.7
1978	12.5	114.8	87.9	146.9	46.8	39.1	6.0	454.0
1979	11.9	144.8	57.2	115.5	39.8	30.1	14.0	413.3
1980	17.3	145.8	90.2	181.6	55.3	37.9	23.3	551.4
1981	18.2	136.5	68.1	187.2	32.3	30.0	13.0	485.3
Total:	82.2	777.1	468.8	845.6	276.5	176.8	91.5	2718.5

The following table summarizes lodgepole pine volume harvested in Canada since 1976.

Lodgepole pine volume cubic meters (m^3) harvested in Canada

Year	British Columbia	Alberta	Total
1976	11,294,324		11,294,324
1977	13,251,860		13,251,860
1978	13,826,032		13,826,032
1979	14,787,455		14,787,455
1980	14,347,504	5,180	14,352,684
1981	12,311,000	77,769	12,388,769
Total:	79,818,175	82,949	79,901,124

Straight salvage harvesting has been discouraged as much as possible. Rather than harvesting old dead material, licensees have been concentrating their activities in active infestation areas in an attempt to slow the spread of the infestation and thereby decrease the amount of future salvage and site rehabilitation required.

The adverse impact of mountain pine beetle in lodgepole pine areas has been recognized in the United States for some time. For example, in 1968 the Deschutes, Fremont, and Winema National Forests prepared a position paper describing a 20-year 88.9 million board feet (MMBF) accelerated harvest plan to cope with a mountain pine beetle outbreak and utilize the anticipated mortality. Considerable progress towards implementing the plan has been made.

Two large National Forest sales in the Western United States reflect the potential impact of a mountain pine beetle infestation. The 318 MMBF Moose Creek Plateau Timber Sale on the Targhee National Forest was sold in August 1960. The sale was offered primarily to invite establishment of a processing facility for small sawtimber in the Upper Snake River Valley. The mountain pine beetle inflicted serious damage to this lodgepole pine sale after it was sold, leaving a substantial portion of the volume unusable. Approximately 143 MMBF has been cut to date and only an estimated 81 MMBF remains.

The 40 MMBF South Pass Timber Sale on the Shoshone National Forest in Wyoming was sold in June 1976. The sale area included not only National Forest but also USDI-Bureau of Land Management, U.S. Steel, and other private lands. The sale was completed in August 1981 with a total of 26 MMBF removed; a reduction of 14 MMBF due to mountain pine beetle.

Special market developments

Lodgepole pine has had a market history as a marginal species. It is readily accepted during normal and high market periods, but is the first species to fall out during a declining market and the last to reenter a recovering market.

Primary markets for lodgepole pine have been chips, dimension lumber, and studs. Some 1-inch lumber is produced from green lodgepole, but because of log size, special drying requirements, and low grades produced, it does not compete well in the market place with other species. Traditionally, dead lodgepole pine is used primarily for studs and chips. Although local markets exist for pallet boards, house logs, mine props, power poles, corral poles, and firewood, they are based on very limited to moderate demand and, except for firewood, may use only select portions of total volumes available.

Recent fuelwood market developments appear to offer considerable expansion opportunity. In local markets where firewood demand is high, innovative sale procedures can accelerate small lot sales to individual homeowners. Green or dead lodgepole that may have to be cut and removed can be sold by the cord or small truck load. For example, in Montana, the use of fuelwood permits resulted in the removal of 327,000 cords of fuelwood during 1981. Local timber appraisal procedures for public lands have been developed that recognize the value of dead lodgepole pine. Recovery of products has been determined through mill studies, and appraisal procedures now reflect a reduced selling value, a reduction in overrun, and an increase in manufacturing costs compared to live trees. Cooperative efforts between National Forests and industry in the United States recently substantially increased the lodgepole pine timber sell program. A reasonable balance of other species and size classes is being maintained to continue profits associated with mill capability and product mix. Dead lodgepole pine offerings are part of currrent 5-year sales programs on all affected National Forests in the United States.

In British Columbia, there has been only limited study of lumber recovery and degrade from killed lodgepole pine. A timber appraisal procedure has been developed that recognizes the decreased value of killed lodgepole pine. Operators directed into stands infested by mountain pine beetle for salvage receive all wood harvested (healthy, green, red or grey attacked) at one-quarter of minimum stumpage.

Alberta encourages the salvage of infested pine stands by applying salvage stumpage rates which are 25 percent of the green timber rate with the reforestation requirements waived. At the same time, volumes produced are made optional to the Alberta quota system; i.e., they are first automatically charged, but the quota-holder may replace them, at his option, with additional production of green coniferous timber. To compensate for the loss of market for chip content in affected pine logs, a subsidy of $7.92 per cubic meter harvested was commenced in November of 1981. To June 30, 1982, this subsidy has been paid on a total of 49,728 m^3 of damaged pine. Affected stands are inspected before harvest to determine the

percentage of damaged pine included. The full stumpage rate and reforestation responsibility still apply to uninfested pine and spruce harvested with the damaged pine and no subsidy is paid for this timber.

Special logging equipment modifications and development

Terrain and access constraints are major considerations influencing the efficiency of harvesting systems in the Rocky Mountain area. Much of the underutilized lodgepole pine resource in question is located on steep, irregular terrain, often complicated by the presence of highly erosive soils. Slopes are frequently convex, creating deflection problems for single span cable yarding systems. Both environmental and economic concerns limit road access and dictate road location and design standards. Landings may frequently be restricted to the road surface itself. Cable harvesting systems--one means of harvesting wood in such circumstances--need to incorporate uphill and downhill yarding capability, extended span reach and/or intermediate support capability, and ability to operate from narrow roads without constructed landings. In small-stem stands and in stands of larger timber as well, volume per acre available for removal is often relatively low. Harvesting systems must be mobile, easily set up or rigged, and capable of extended reach or travel to operate economically in such stands.

Improved or new harvesting systems must be capable of handling large numbers of small stems, frequently on steep or irregular terrain with limited access, and often under partial cut prescriptions. Important criteria to be considered in the development of new systems include:

--Reduced capital investment requirements;

--Reduced dependence on conventional road systems, and increased flexibility with respect to road location and standards;

--Capability to operate efficiently on steep, irregular terrain and convex slopes;

--Capability to efficiently bunch and handle small stems, including selection harvesting or thinning as well as clearcutting;

--Improved mobility and ease of rigging for cable systems;

--Compatibility with interfacing handling and transportation systems.

Current effort underway in the United States is directed toward evaluating the performance of both domestic and foreign equipment and systems in small-stem stands; developing improved systems and techniques for prebunching and whole-stem recovery and processing; and developing new concepts for forwarding material over unroaded areas. Lightweight, low capital investment cable systems are presently being field tested in the intermountain West. European-made bunching winches are also being field tested as a means of prebunching for cable or aerial swing systems or

grapple skidders. Systems that incorporate new generation feller-bunchers, grapple skidders, and whole tree delimber-processors are being evaluated under a variety of stand and terrain conditions. New concepts for long-reach cable forwarding systems that can significantly reduce road requirements are currently in the engineering feasiblity analysis stage.

International efforts

There is considerable concern over possible mountain pine beetle migration across the international Canada/U.S. border. Mutual water quality, scenic quality, and wildlife habitat suitability problems are currently developing. Special cooperative efforts are needed to cope with outbreaks of mountain pine beetle along the Canada/U.S. border.

As a result, meetings have been held and actions are being agreed upon to jointly accelerate salvage and use of trees currently being killed; improve and share biological and economic data; refine silvicultural techniques through research and development; develop parallel programs; and exchange scientists, specialists, and information.

The two countries, operating through the affected States, Provinces, other governmental agencies, and private landowners, will assist each other in planning and conducting corrective forestry programs, especially in border situations, and in sharing research information.

APPENDIX I

STATUS OF U.S. MOUNTAIN PINE BEETLE INFESTATIONS IN LODGEPOLE PINE BY STATE, 1981

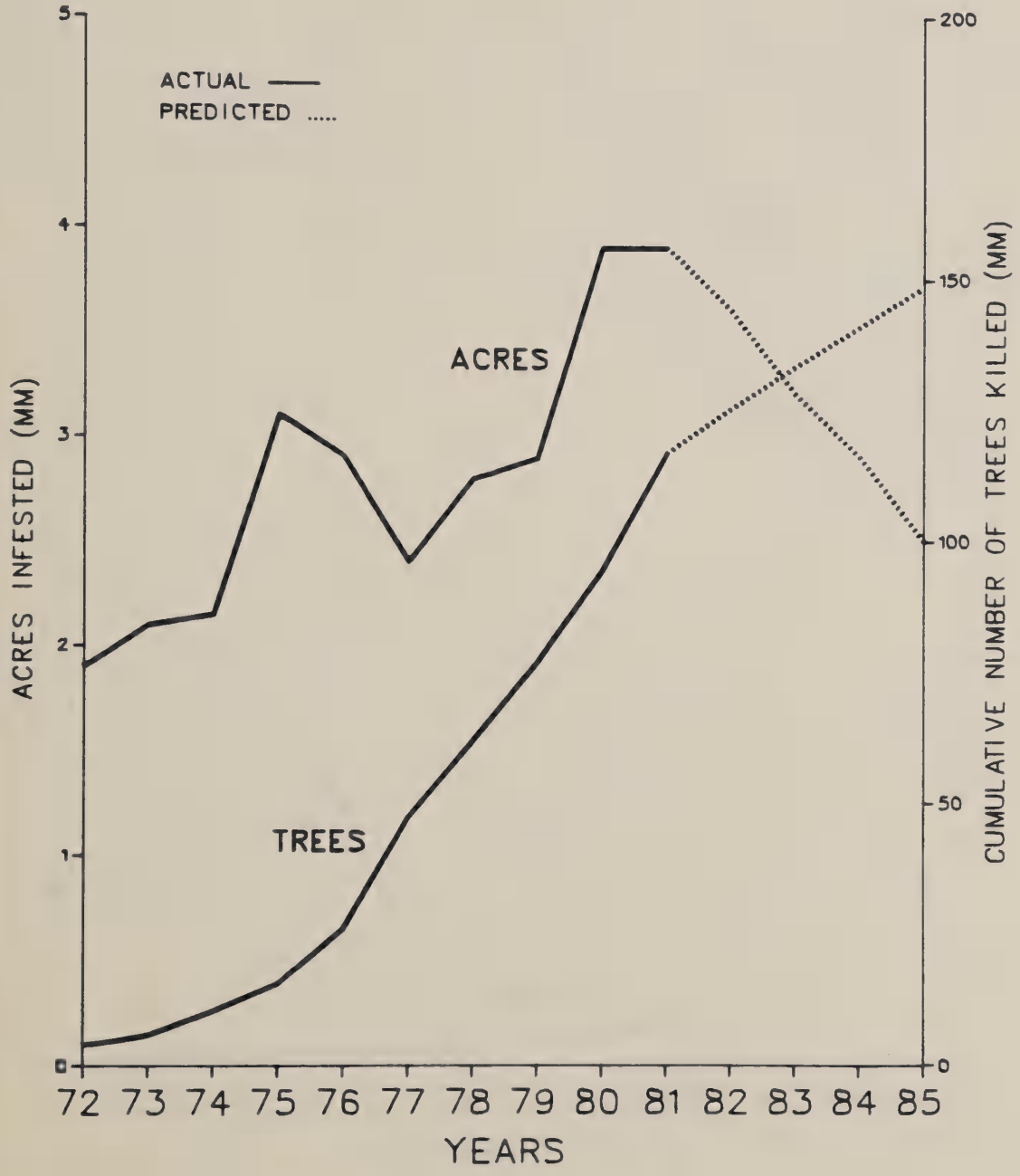
State	Land Ownership Class	Thousands of Acres Infested	Thousands of Trees Killed	Volume Killed (MCF)
Colorado	National Forest....	20.5	46.4	376.8
	Other Federal.....	4.1	6.8	55.8
	State & Private....	12.4	21.8	177.0
	Total.....	37.0	75.0	609.6
Idaho	National Forest....	593.8	447.0	5987.9
	Other Federal.....	0.0	0.0	0.0
	State & Private...	70.4	177.5	3907.4
	Total.....	664.2	624.5 ±14%	9895.3 ±15%
Montana	National Forest....	806.0	3019.8	36237.6
	Other Federal.....	1159.4	4396.3	107.4
	State & Private....	387.0	1201.8	14421.6
	Total.....	2352.4	8617.9	50766.6
Oregon	National Forest....	453.2	2586.9	30822.4
	Other Federal.....	13.9	90.2	1075.2
	State & Private....	55.0	330.9	3942.4
	Total.....	522.1	3008.0 ±17.8%	35840.0 ±20.8%
Utah	National Forest....	148.5	72.8	862.0
	Other Federal.....	2.6	1.5	18.0
	State & Private....	3.1	1.5	18.0
	Total.....	154.2	75.8 ±24%	898.0 ±28%
Washington	National Forest....	36.6	52.6	765.7
	Other Federal.....	1.9	2.9	39.4
	State & Private....	1.6	2.3	33.5
	Total.....	40.1	57.8 ±23.4%	838.6 ±24.7%
Wyoming	National Forest....	34.9	10.8	148.5
	Other Federal.....	2.2	.7	9.3
	State & Private....	.1	.03	.4
	Total.....	37.2	11.5 ±36%	158.2 ±41%

The numbers of trees killed do not include infested trees removed as a result of suppression projects, some timber salvage operations, or firewood gathering. The volume killed figures also do not include the volume of timber in the trees killed in National Parks, National Monuments, Wilderness areas, or similar nontimber producing dedicated areas.

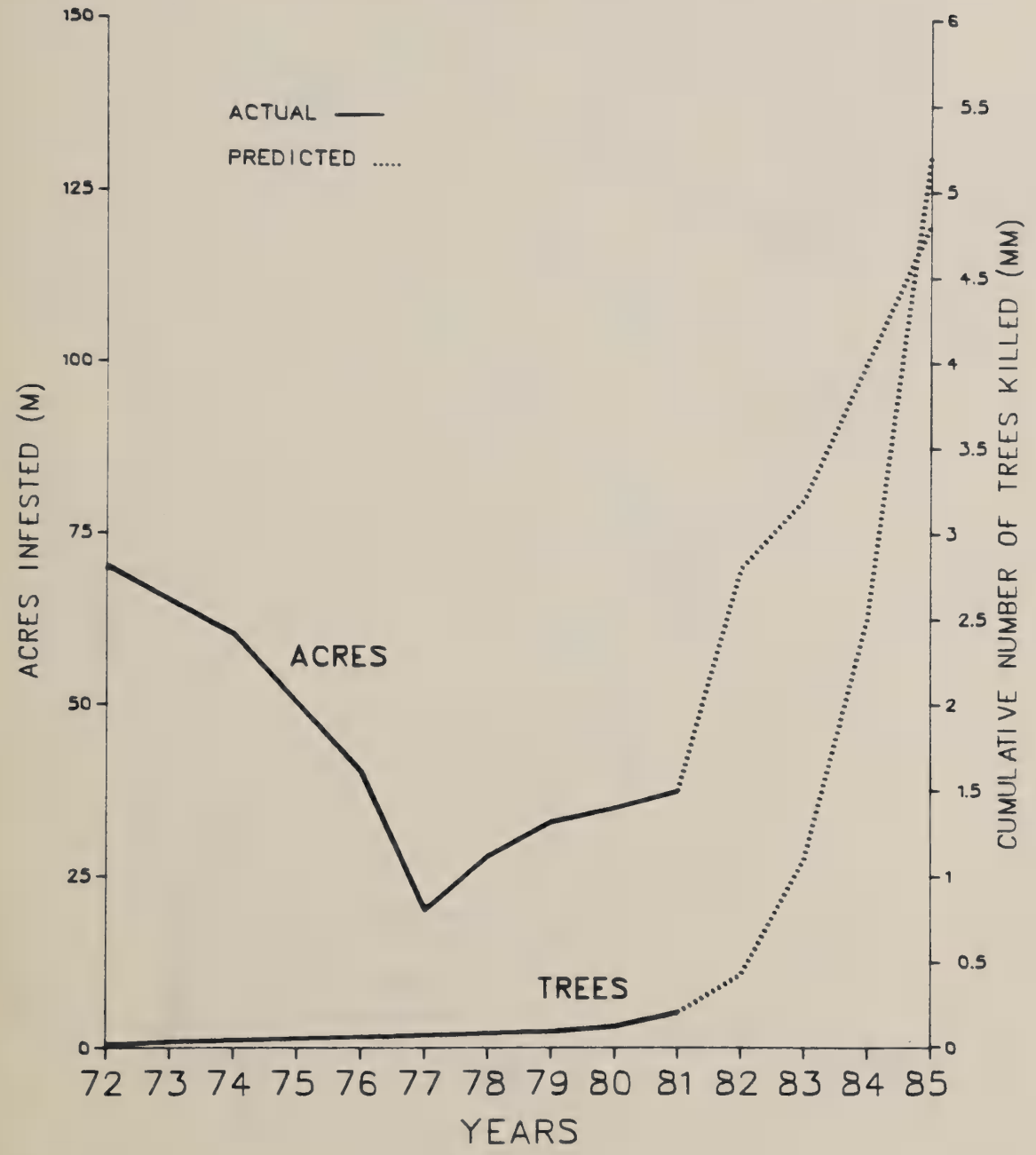
Because estimates for Colorado and Montana are based on aerial sketch mapping only, no standard error estimate can be made. The estimates for all other States are based on a two-stage aerial photography survey.

APPENDIX II ACRES INFESTED AND AMOUNT OF RECENT LODGEPOLE PINE MORTALITY WITH PROJECTIONS THROUGH 1985 FOR EACH WESTERN STATE IN THE UNITED STATES

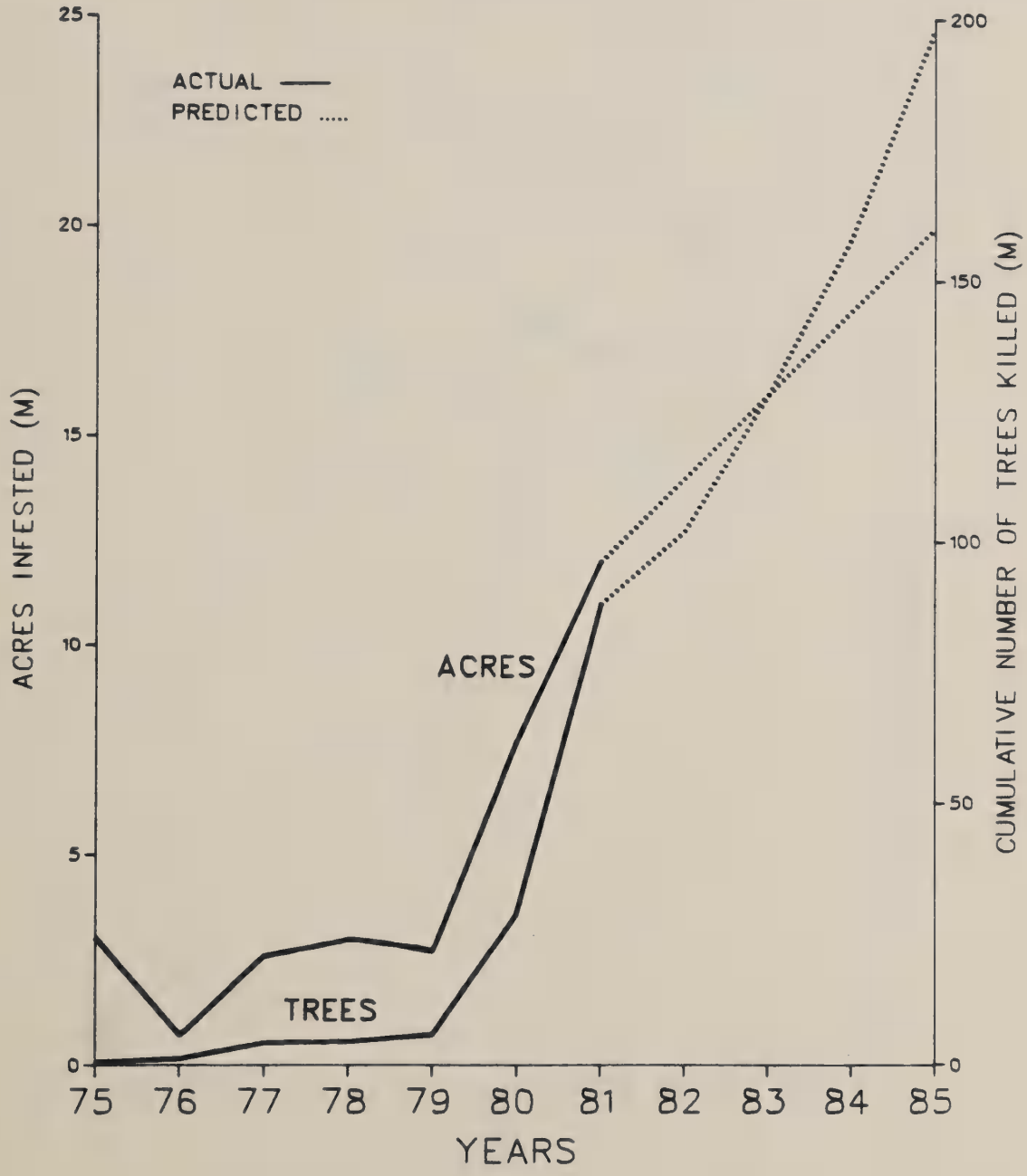
LODGEPOLE PINE MORTALITY CAUSED BY MPB IN WESTERN UNITED STATES

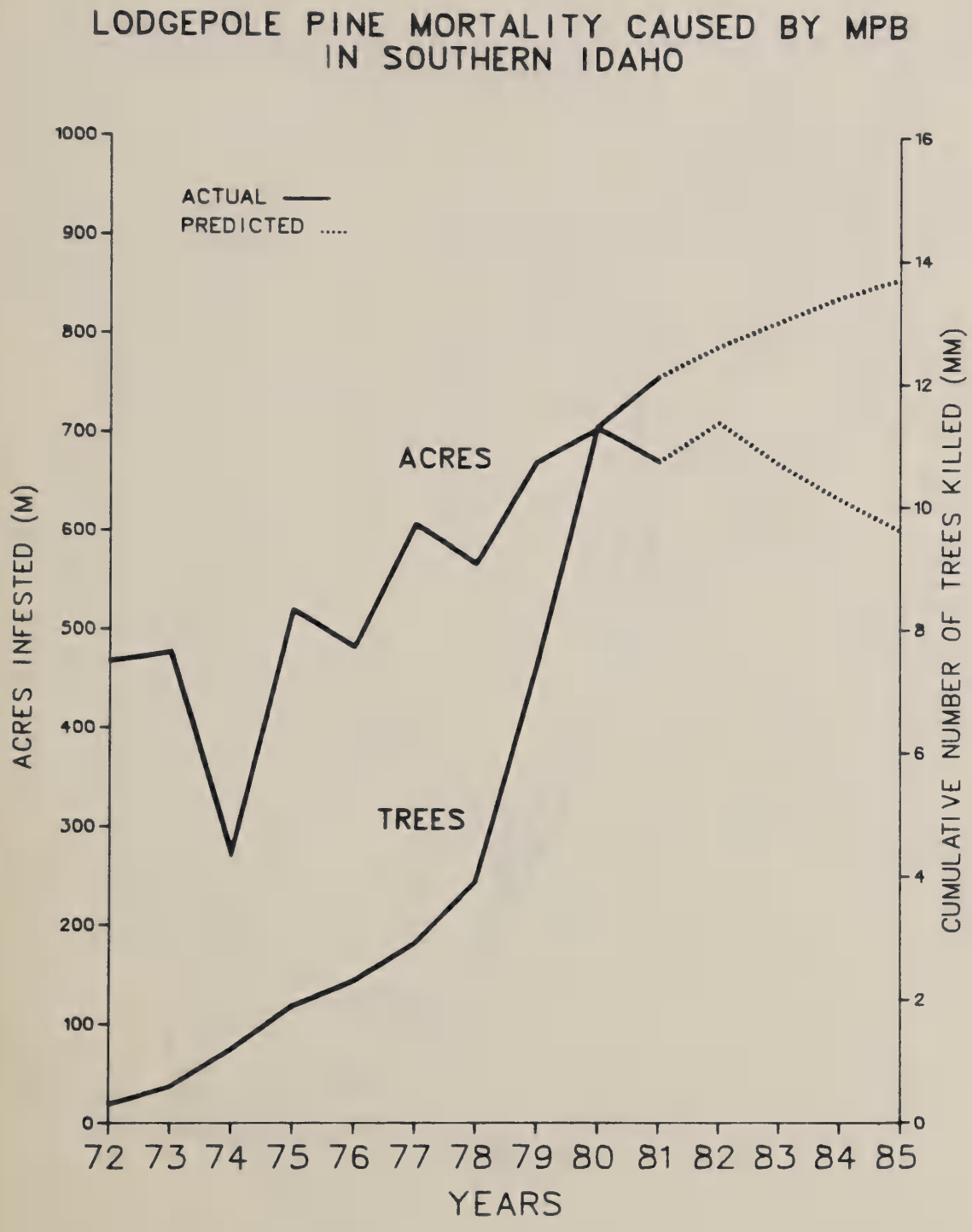


LODGEPOLE PINE MORTALITY CAUSED BY MPB IN COLORADO

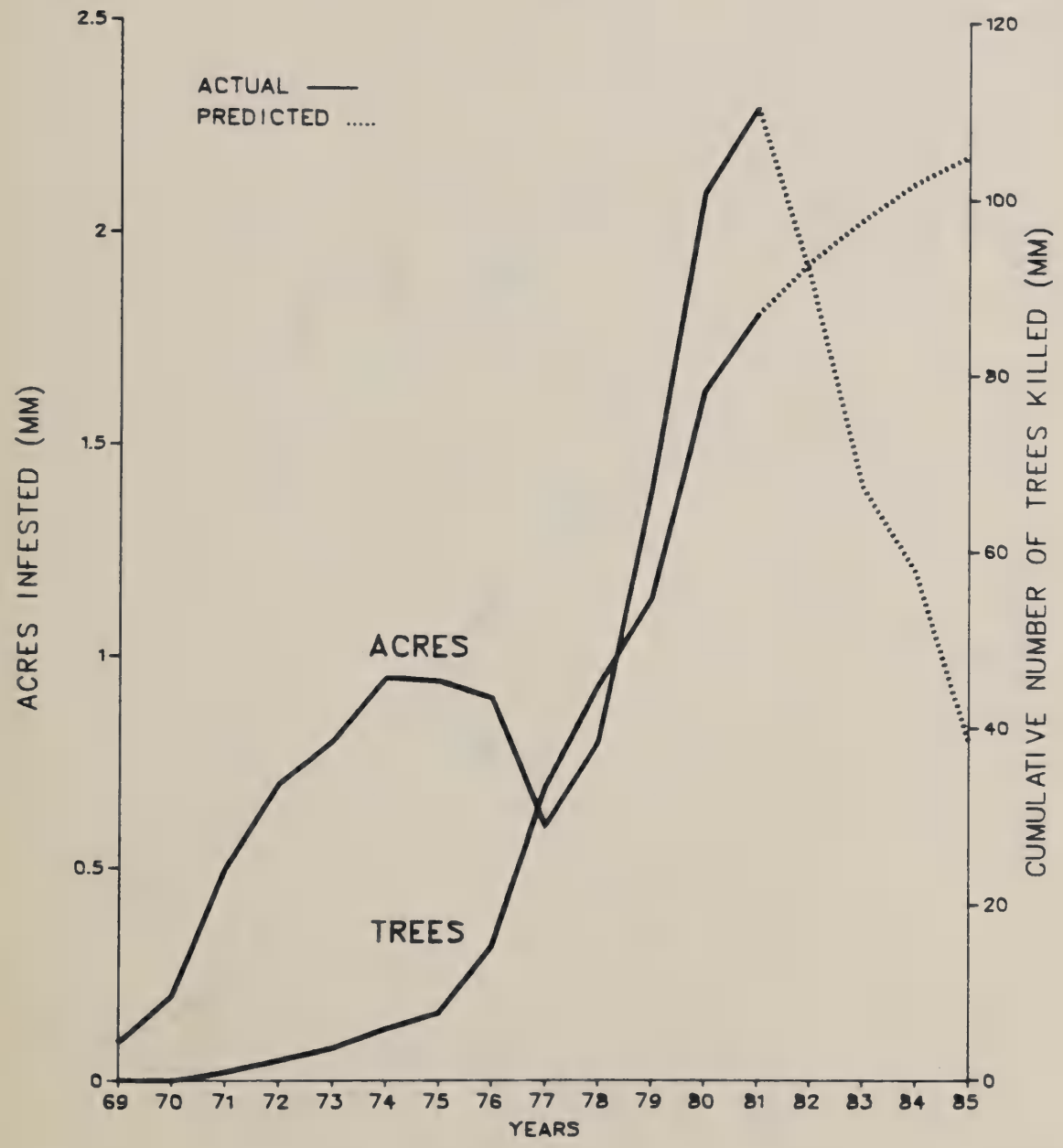


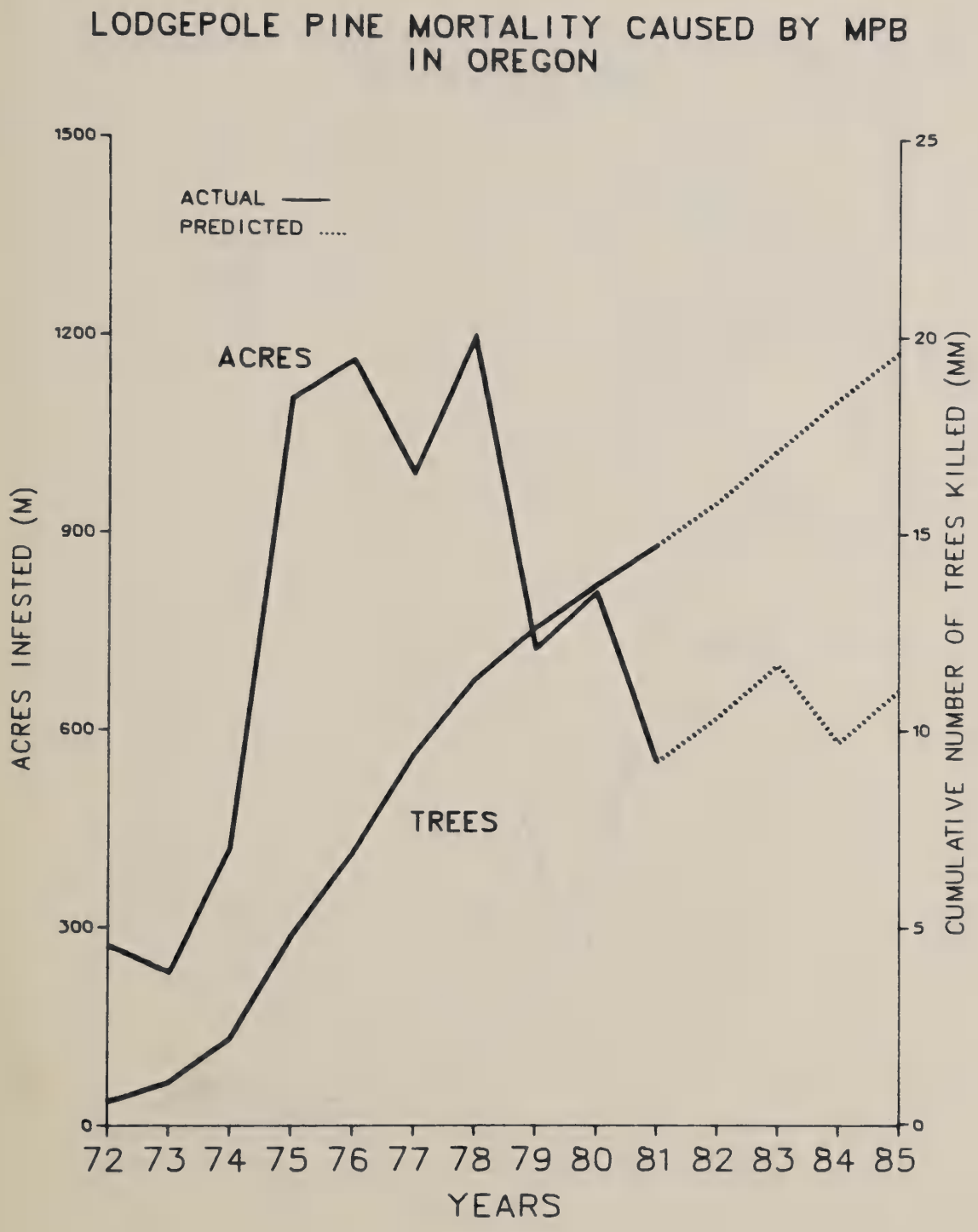
LODGEPOLE PINE MORTALITY CAUSED BY MPB IN NORTHERN IDAHO

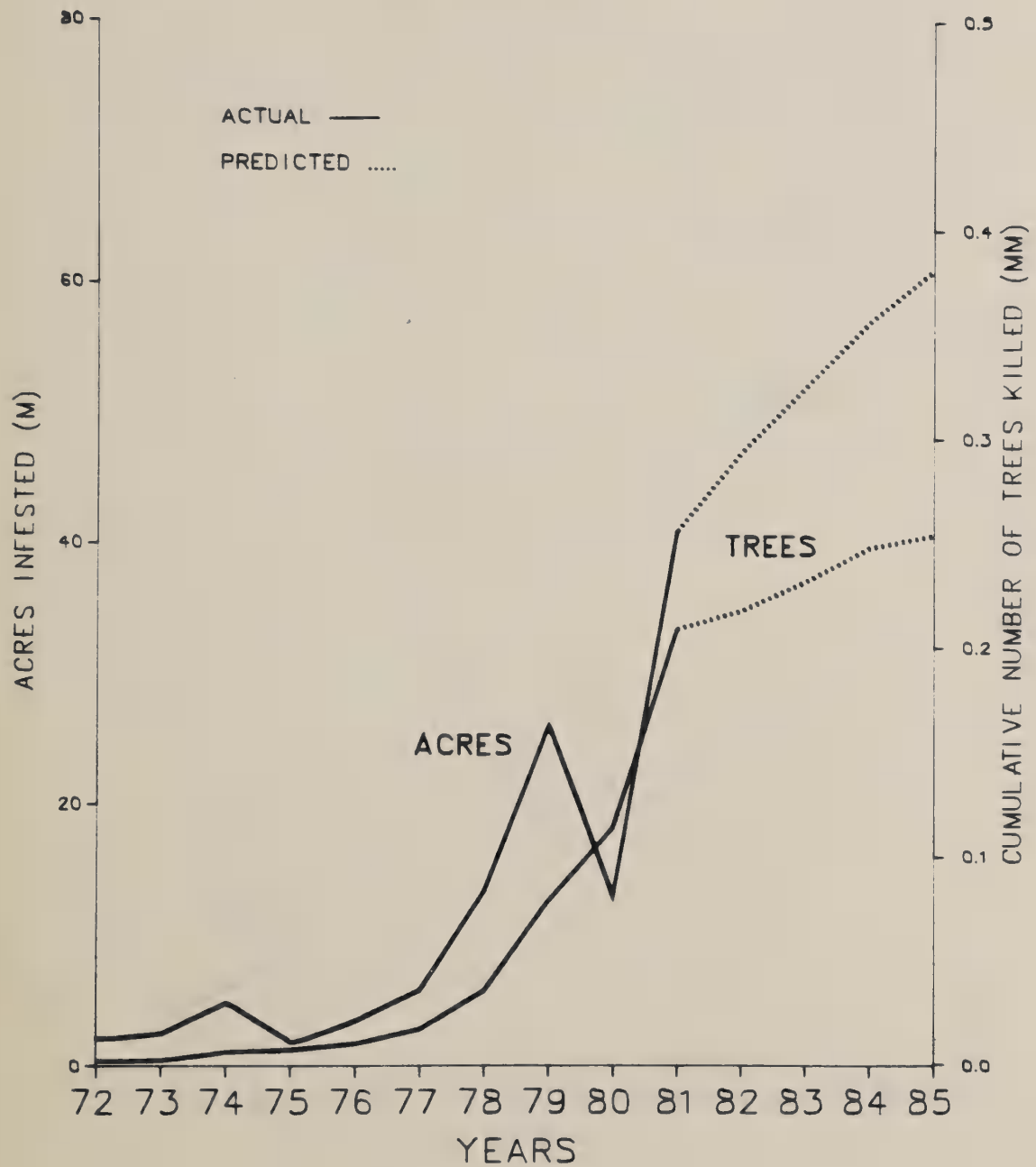


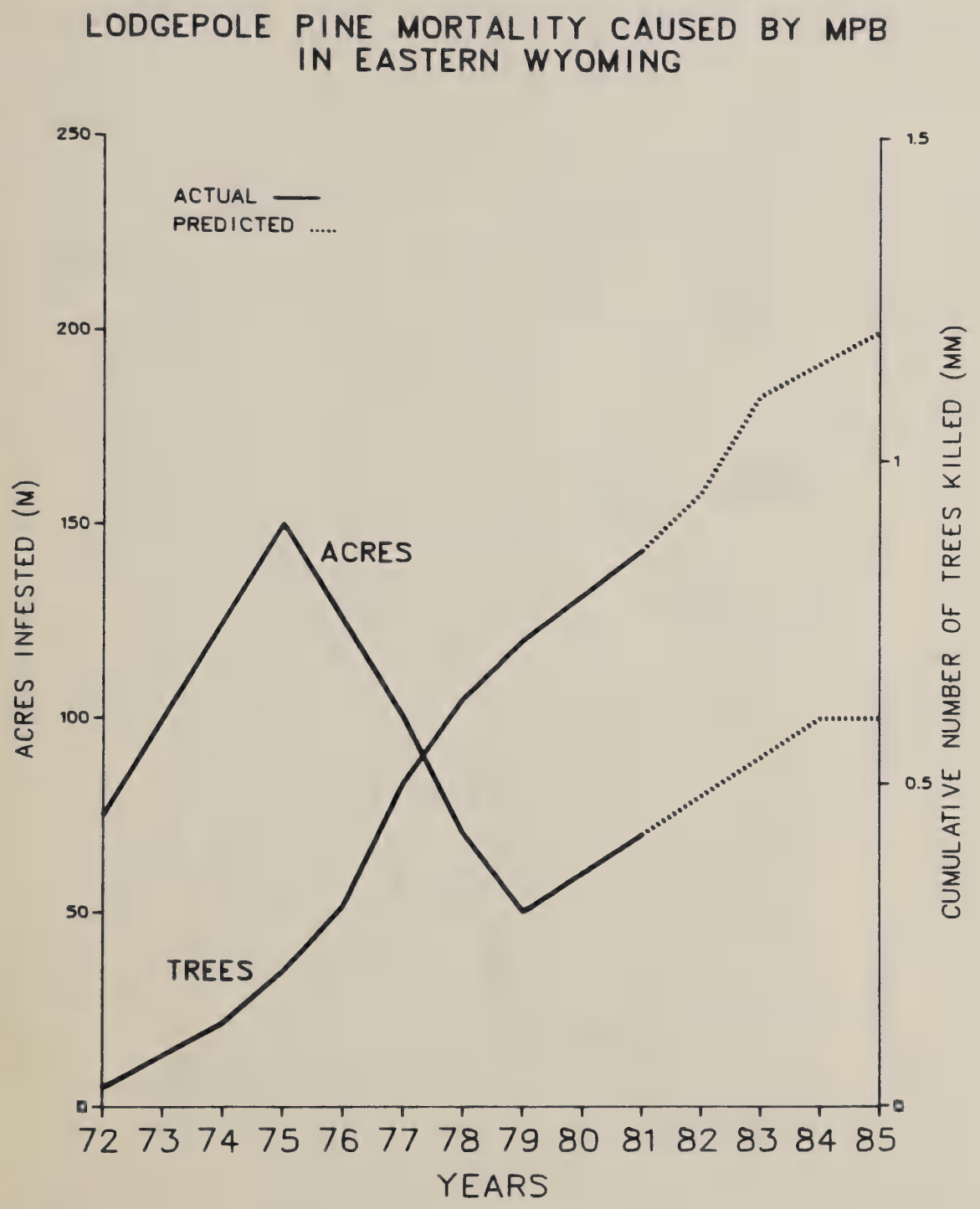

LODGEPOLE PINE MORTALITY CAUSED BY MPB
IN SOUTHERN IDAHO
ACTUAL
PREDICTED
ACRES
TREES
ACRES INFESTED (M)
CUMULATIVE NUMBER OF TREES KILLED (MM)
YEARS
1000
900
800
700
600
500
400
300
200
100
0
16
14
12
10
8
6
4
2
0
72 73 74 75 76 77 78 79 80 81 82 83 84 85

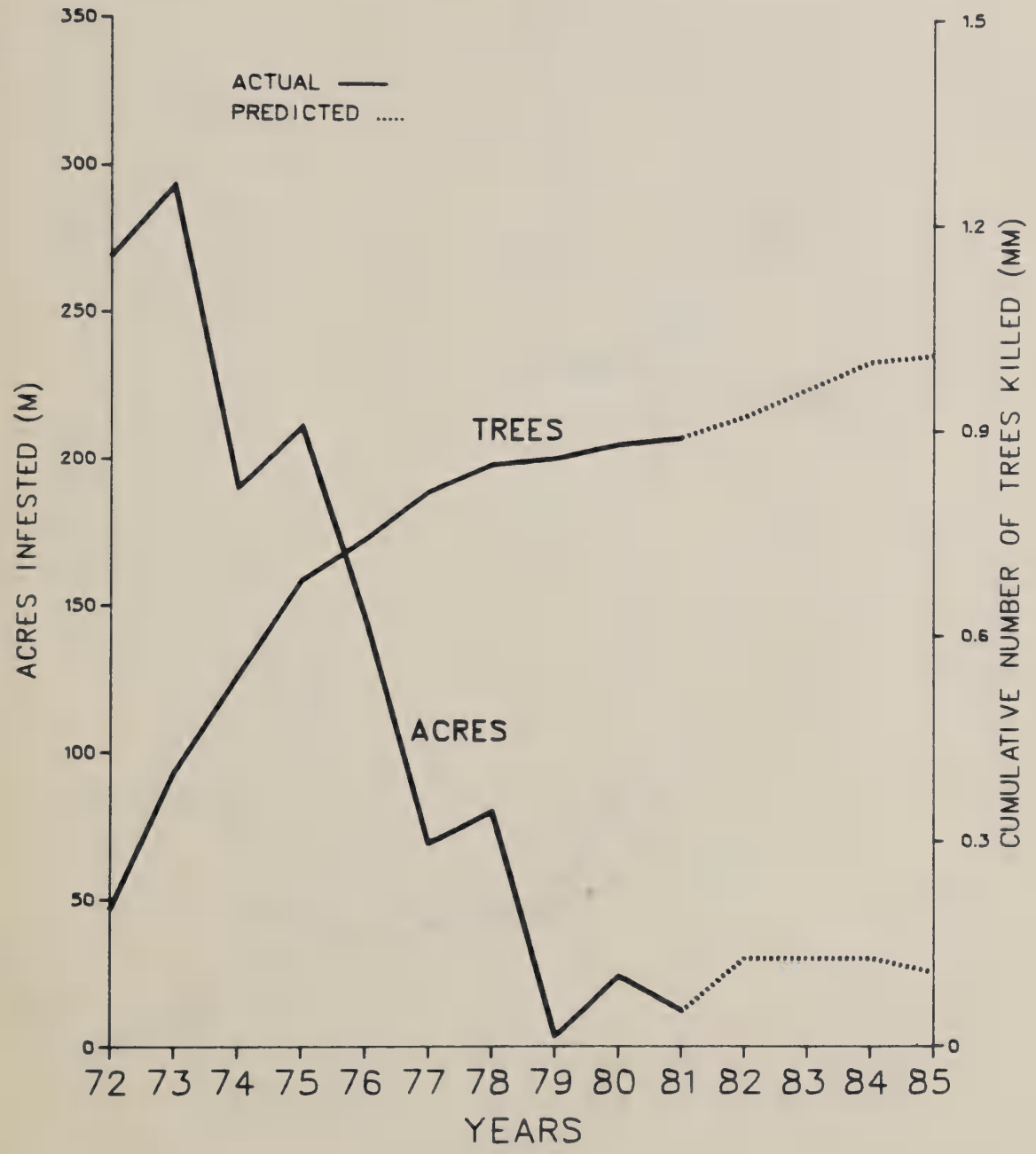
LODGEPOLE PINE MORTALITY CAUSED BY MPB IN MONTANA

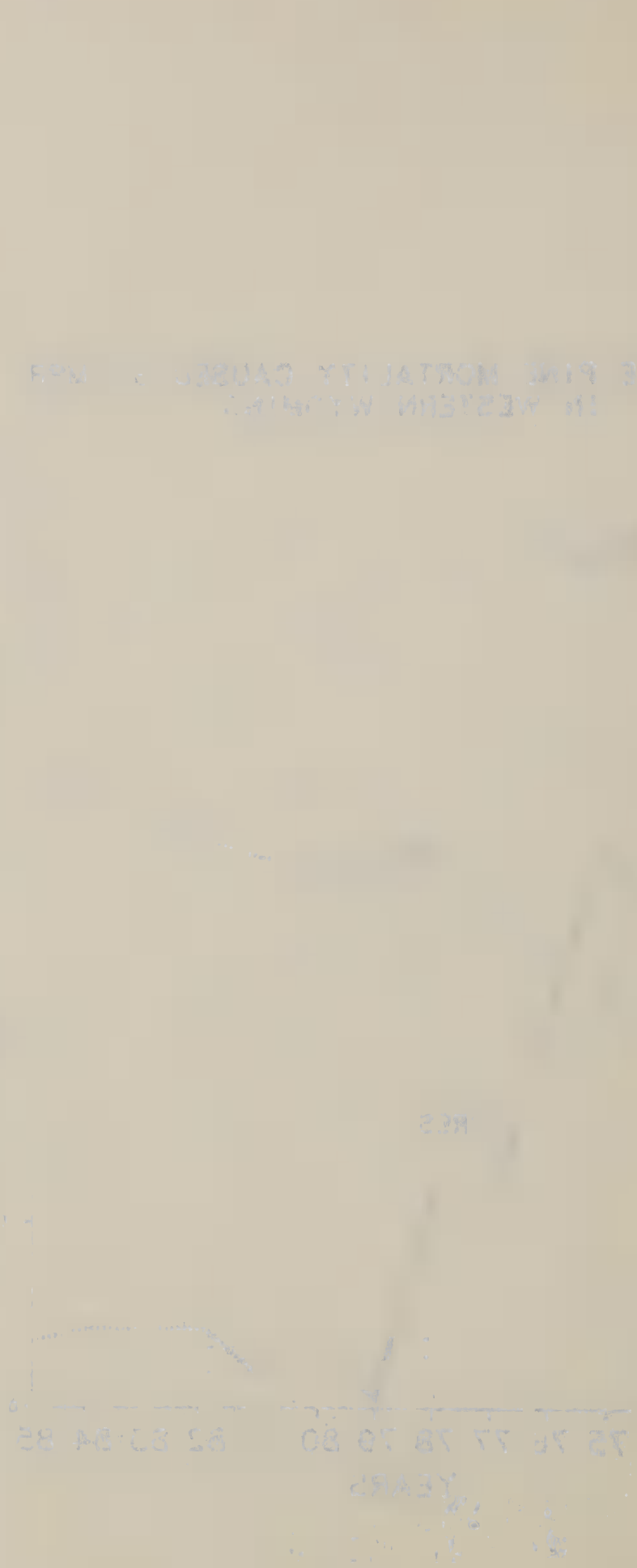



LODGEPOLE PINE MORTALITY CAUSED BY MPB
IN OREGON
ACTUAL
PREDICTED
ACRES
TREES
ACRES INFESTED (M)
CUMULATIVE NUMBER OF TREES KILLED (MM)
1500
1200
900
600
300
0
25
20
15
10
5
0
72 73 74 75 76 77 78 79 80 81 82 83 84 85
YEARS

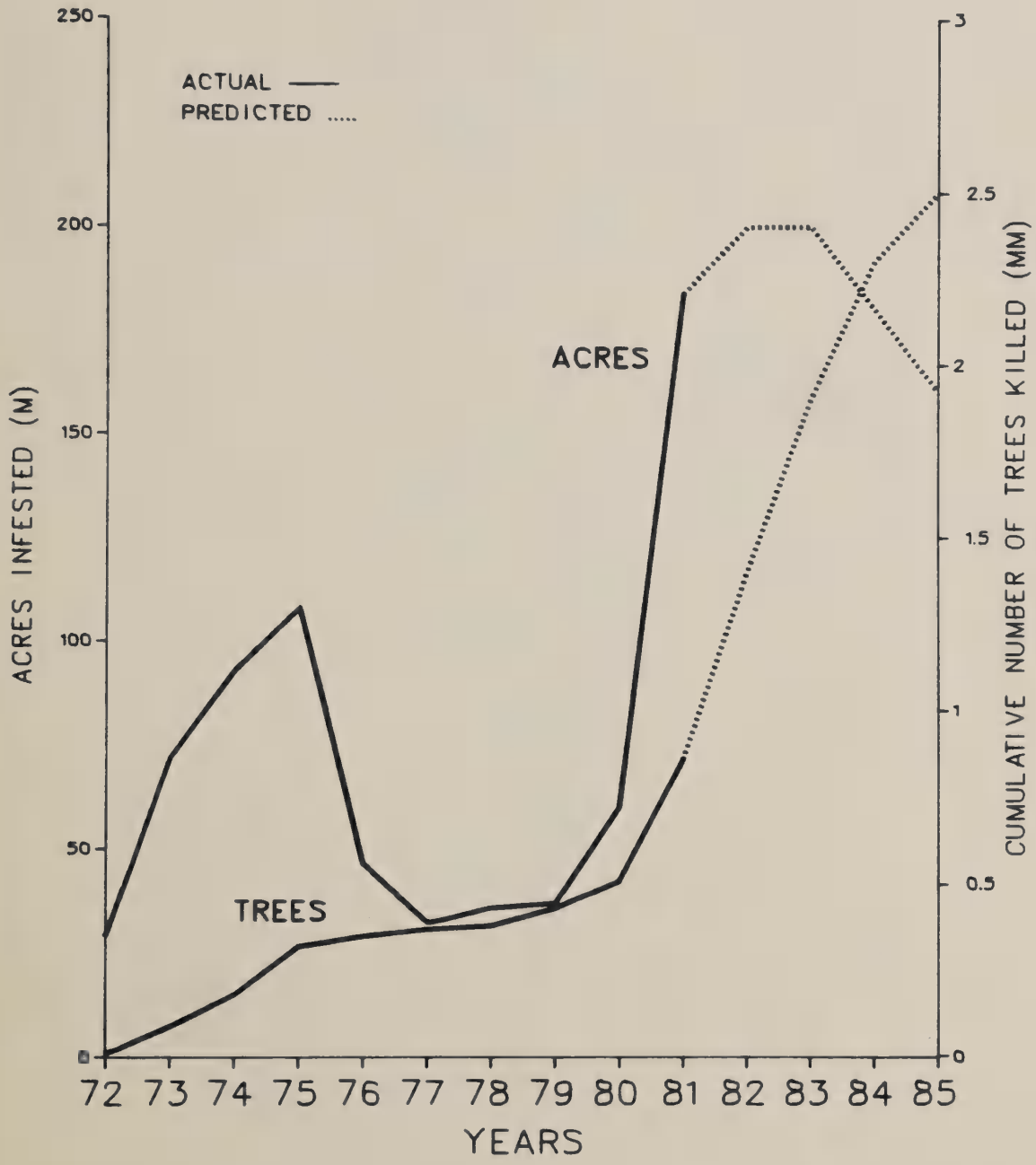

LODGEPOLE PINE MORTALITY CAUSED BY MPB
IN WASHINGTON
ACTUAL
PREDICTED
TREES
ACRES
ACRES INFESTED (M)
CUMULATIVE NUMBER OF TREES KILLED (MM)
YEARS
0
20
40
60
80
0.0
0.1
0.2
0.3
0.4
0.5
72 73 74 75 76 77 78 79 80 81 82 83 84 85


LODGEPOLE PINE MORTALITY CAUSED BY MPB
IN EASTERN WYOMING
ACTUAL
PREDICTED .....
ACRES
TREES
ACRES INFESTED (M)
CUMULATIVE NUMBER OF TREES KILLED (MM)
250
200
150
100
50
0
1.5
1
0.5
0
72 73 74 75 76 77 78 79 80 81 82 83 84 85
YEARS


LODGEPOLE PINE MORTALITY CAUSED BY MPB
IN WESTERN WYOMING
ACTUAL
PREDICTED .....
TREES
ACRES
ACRES INFESTED (M)
CUMULATIVE NUMBER OF TREES KILLED (MM)
350
300
250
200
150
100
50
0
1.5
1.2
0.9
0.6
0.3
0
72 73 74 75 76 77 78 79 80 81 82 83 84 85
YEARS

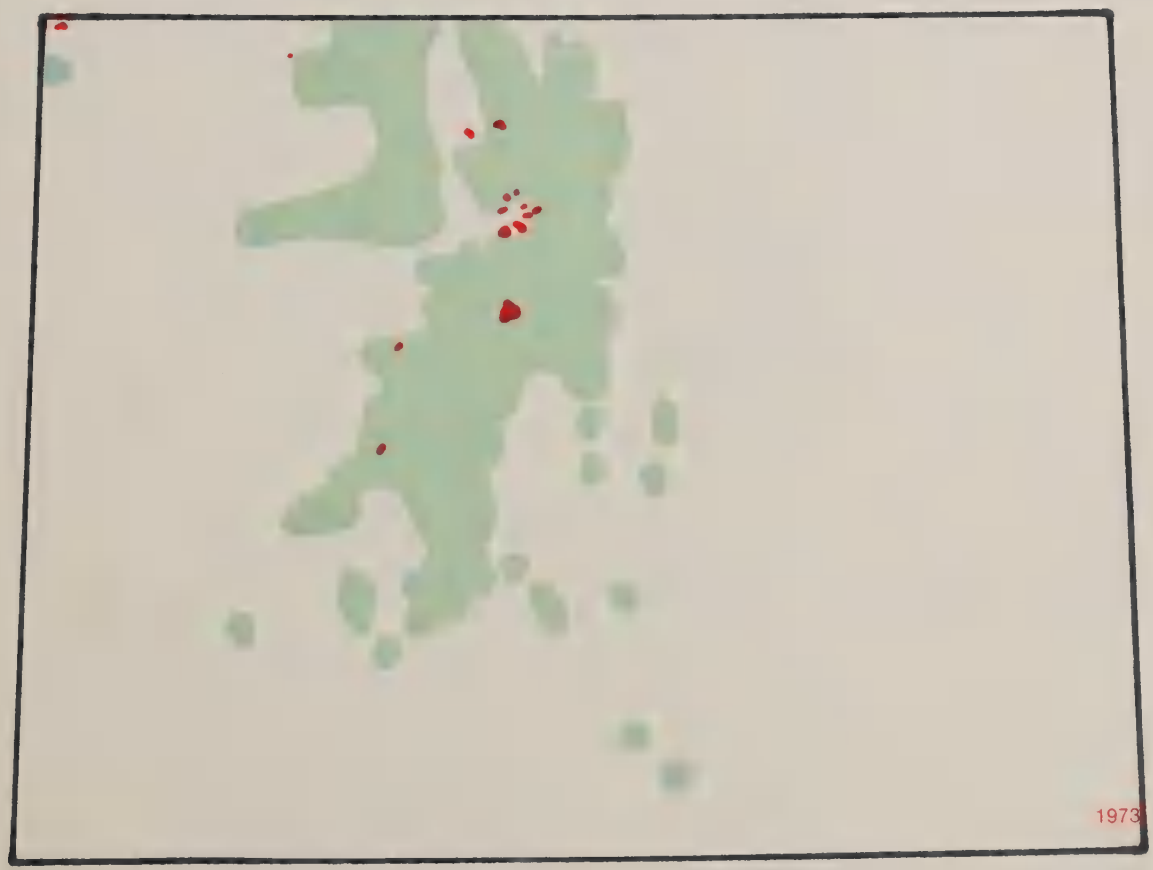


LODGEPOLE PINE MORTALITY CAUSED BY MPB IN UTAH



APPENDIX III

CHRONOLOGICAL MAPS OF LODGEPOLE PINE AREAS AND MOUNTAIN PINE BEETLE INFESTATIONS IN THE UNITED STATES



Areas of mountain pine beetle-infested lodgepole pine in Colorado.

Areas of mountain pine beetle-infested lodgepole pine in Colorado.

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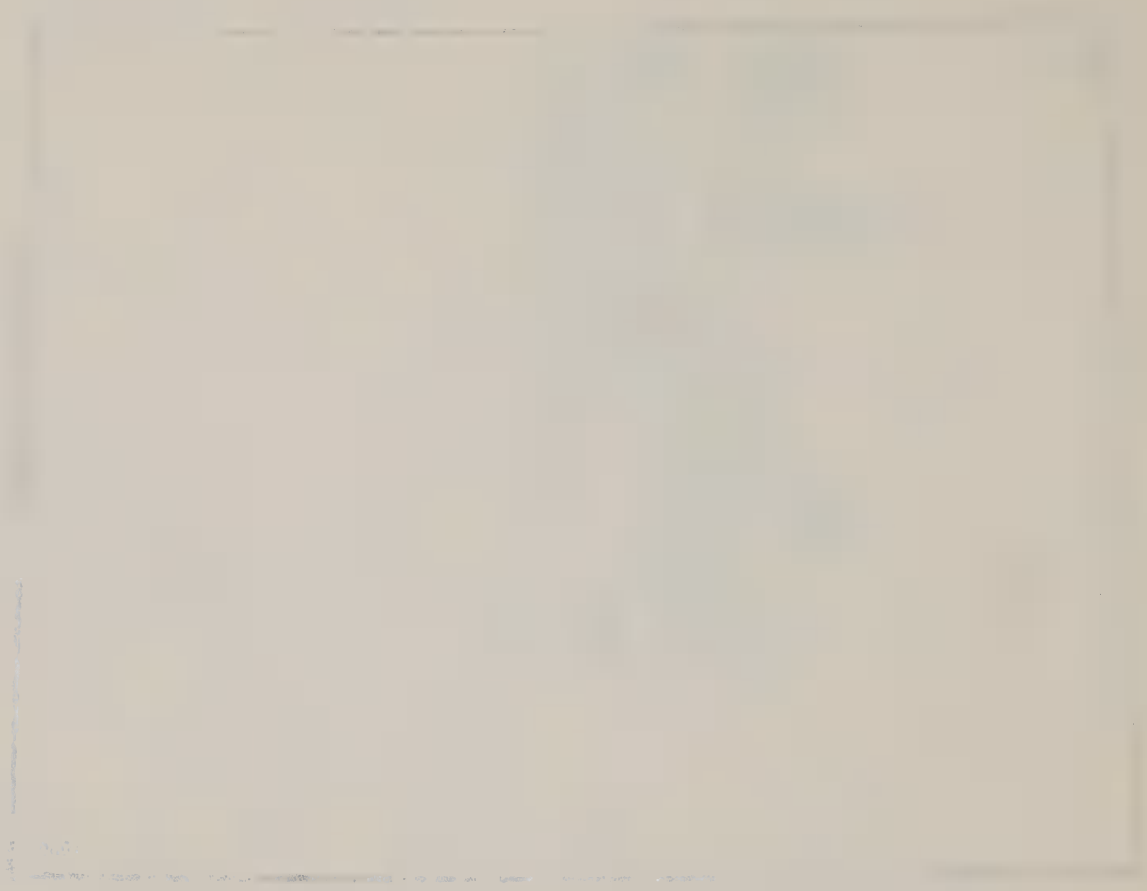
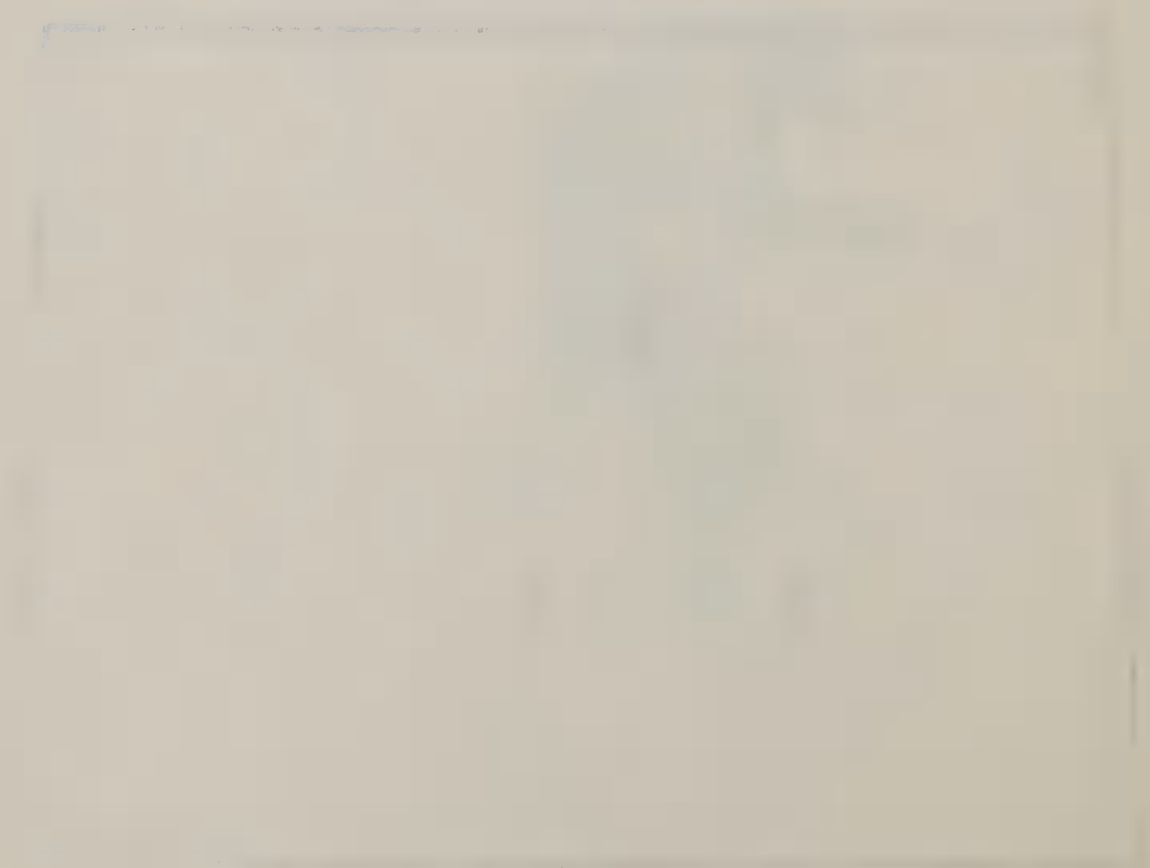
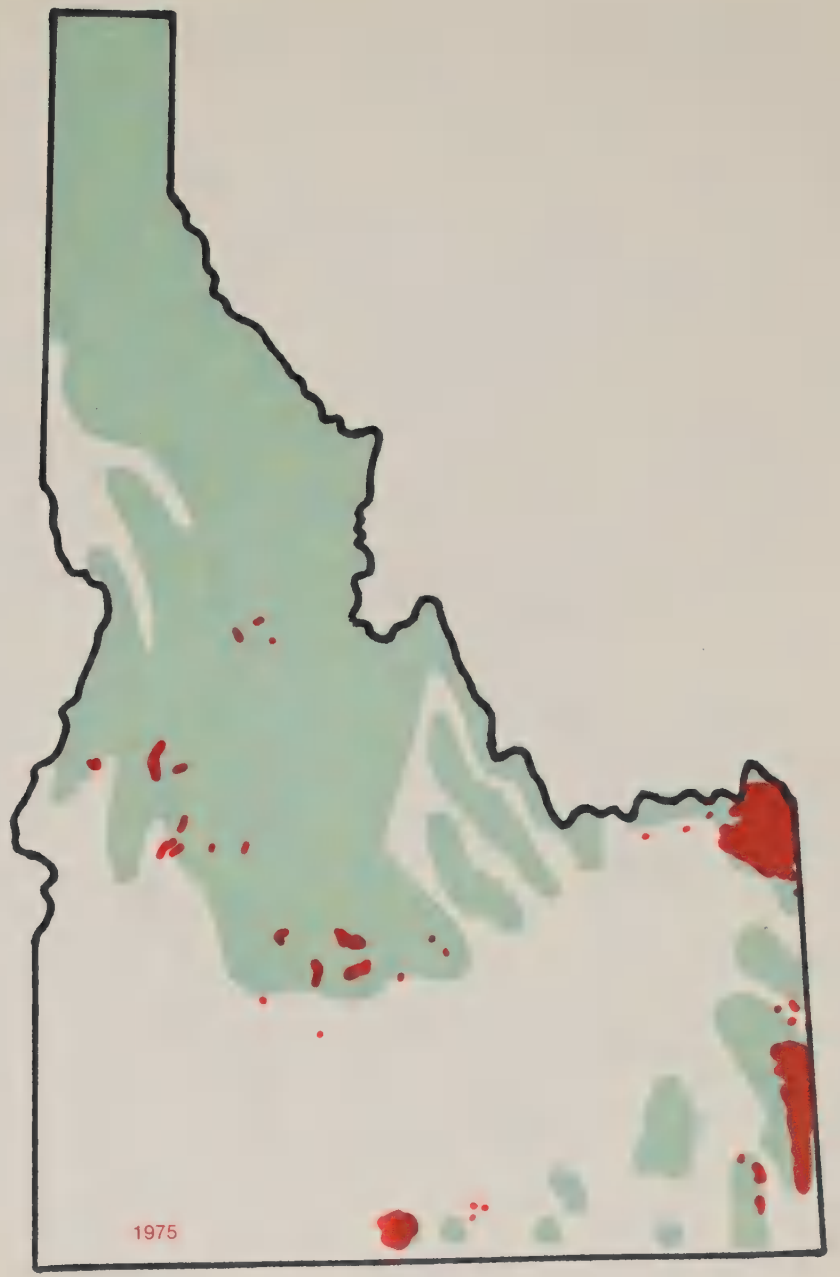
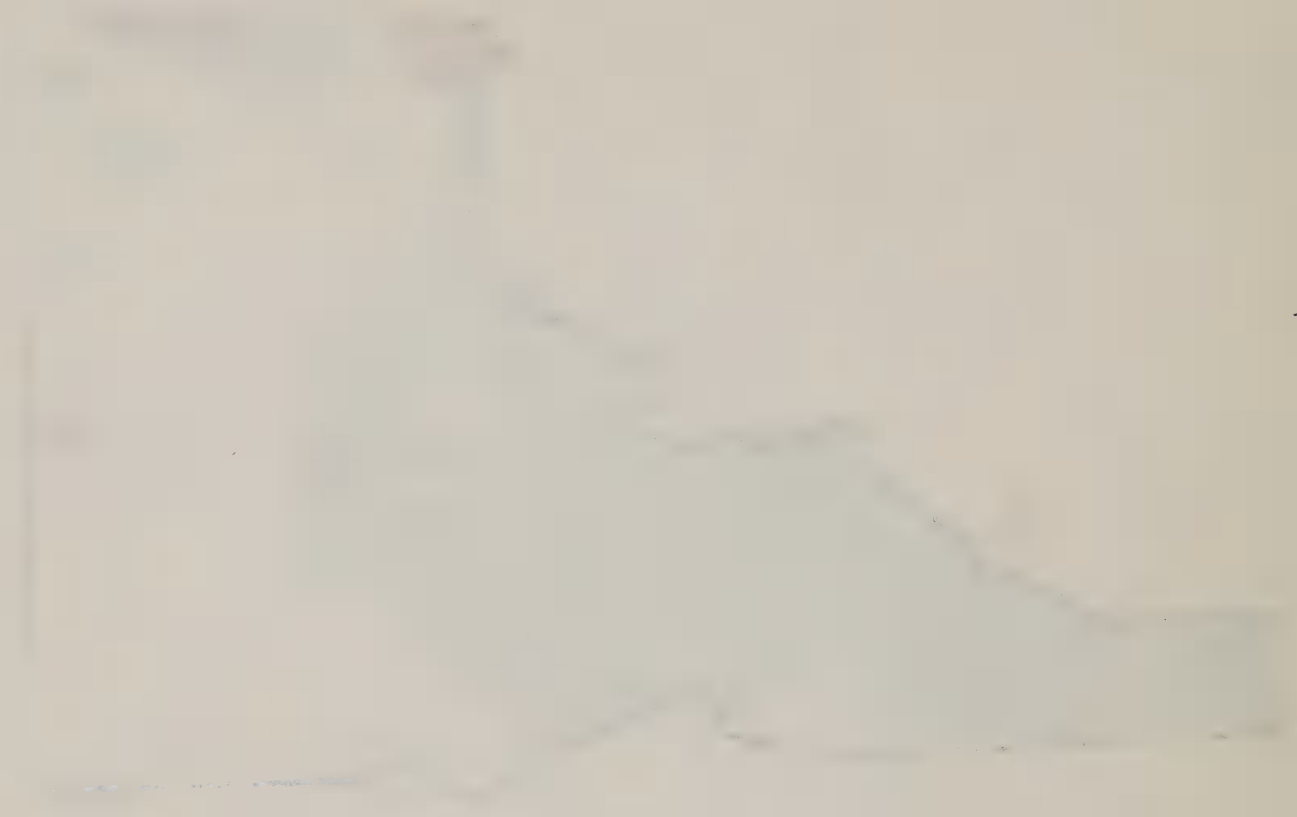




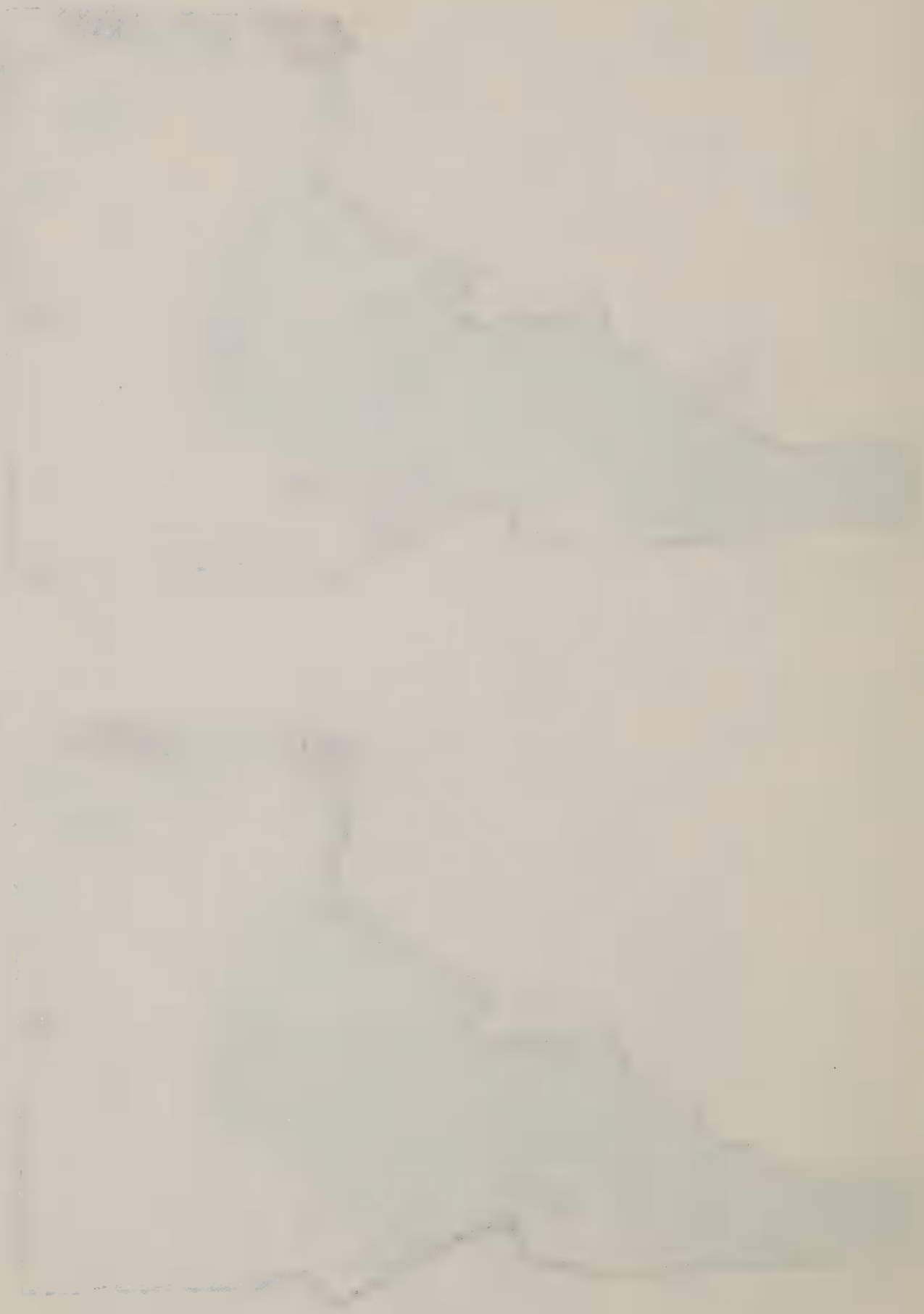
Areas of mountain pine beetle-infested lodgepole pine in Idaho.



Areas of mountain pine beetle-infested lodgepole pine in Idaho.

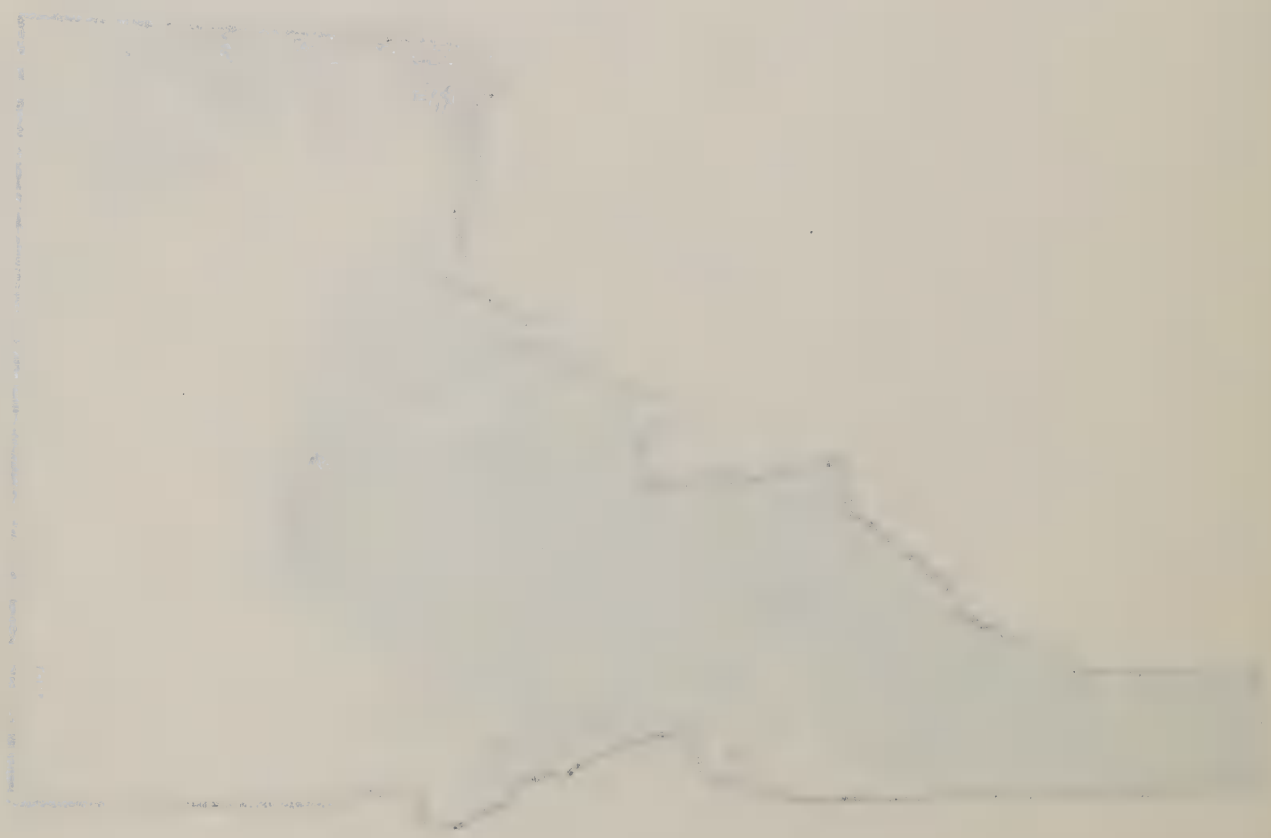


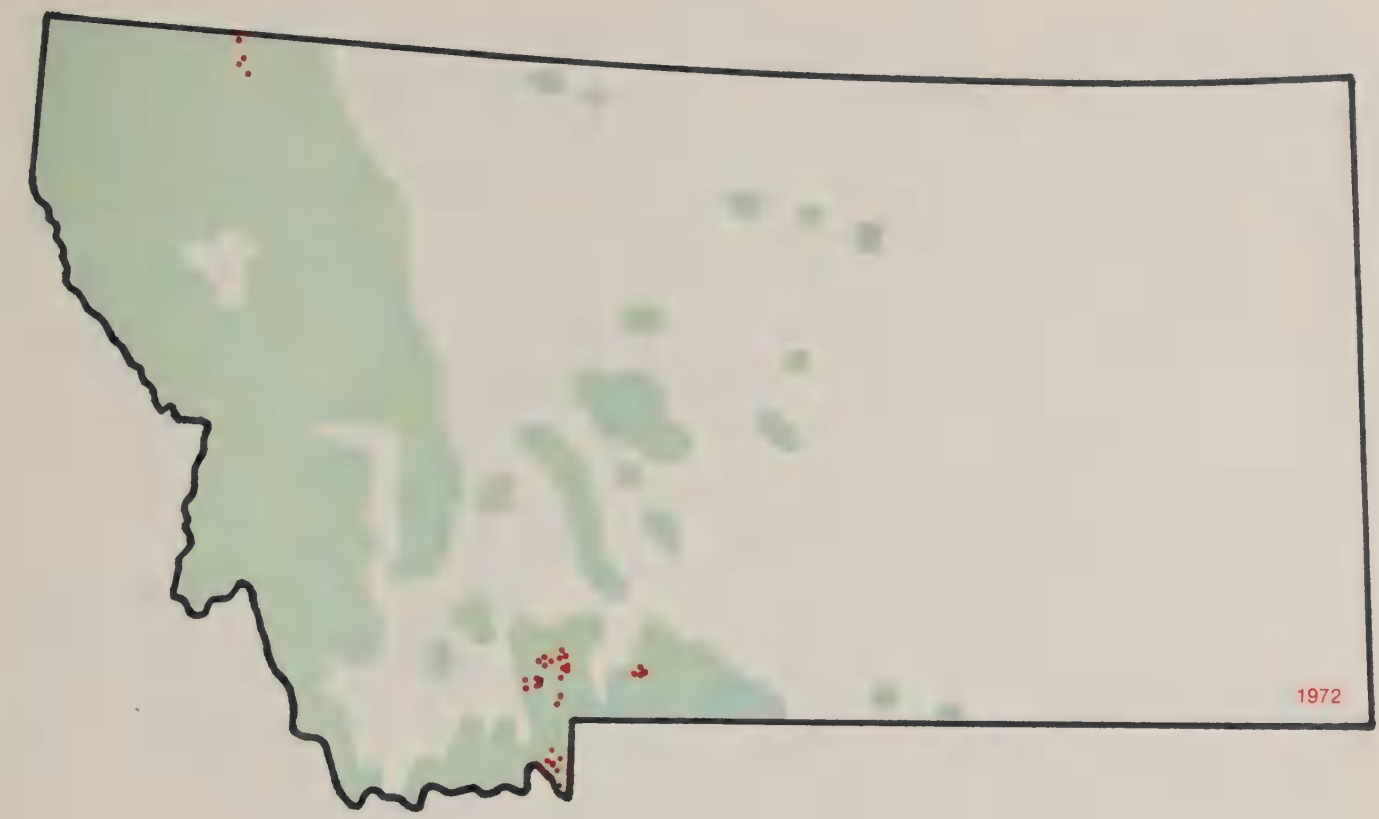
Areas of mountain pine beetle-infested lodgepole pine in Idaho.

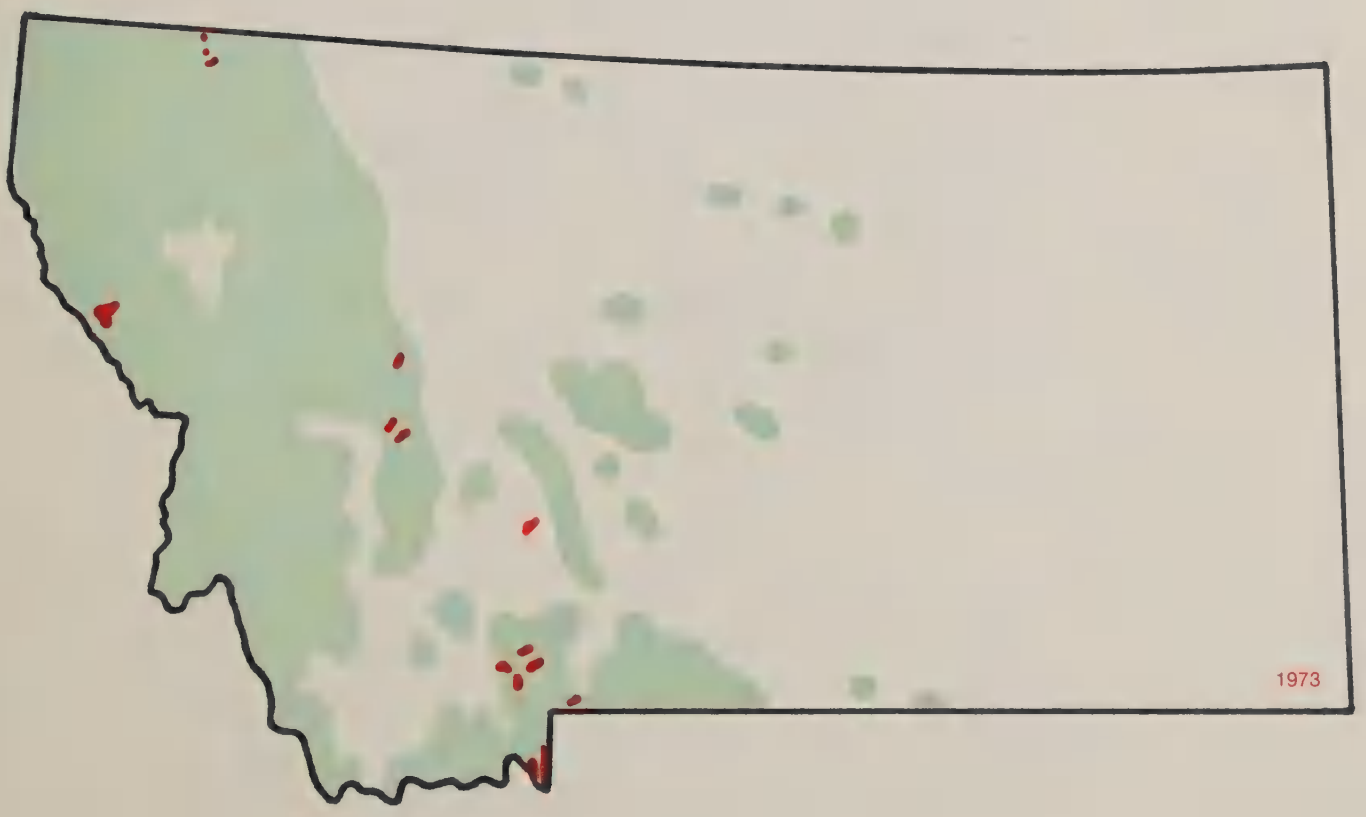


Areas of mountain pine beetle-infested lodgepole pine in Idaho.

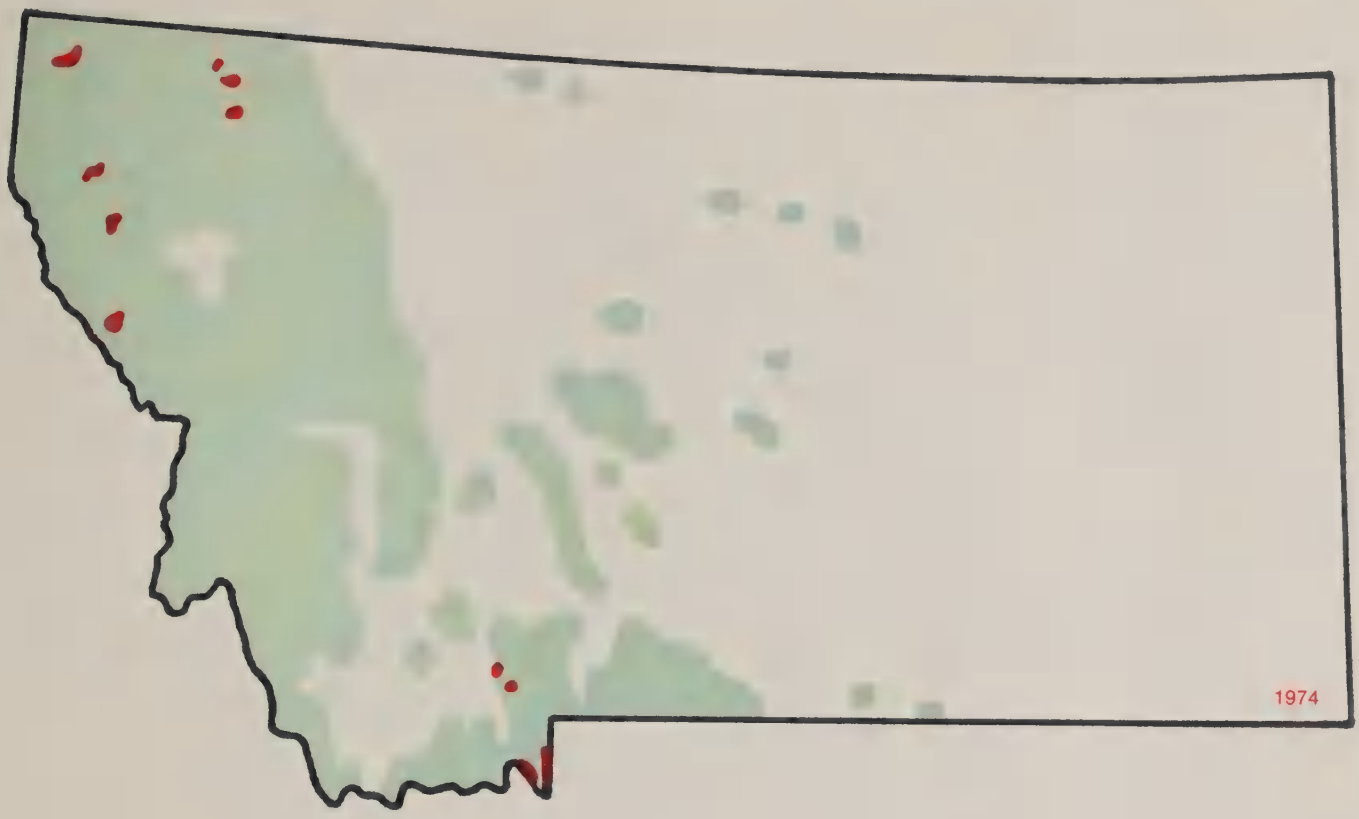
Areas of mountain pine beetle-infested lodgepole pine in Idaho.

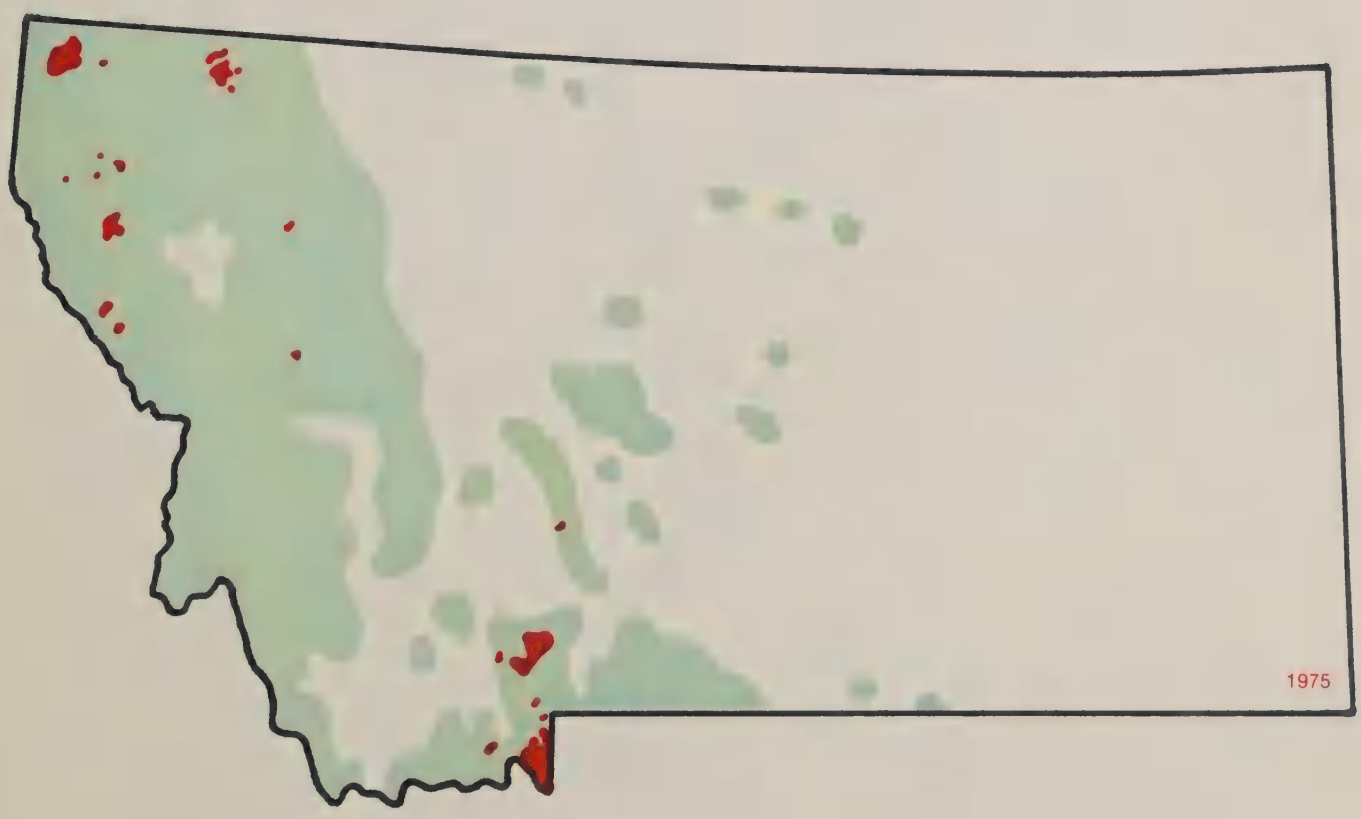




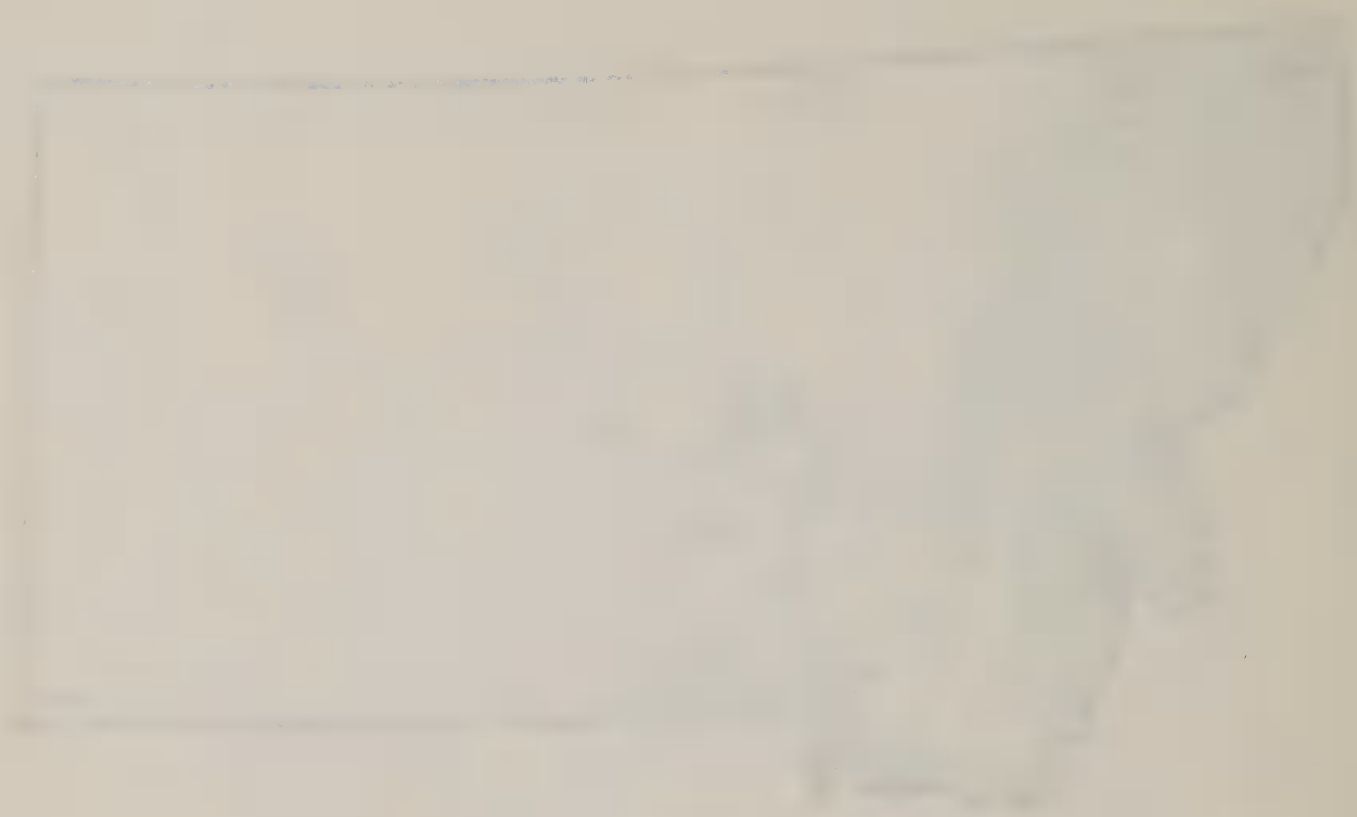


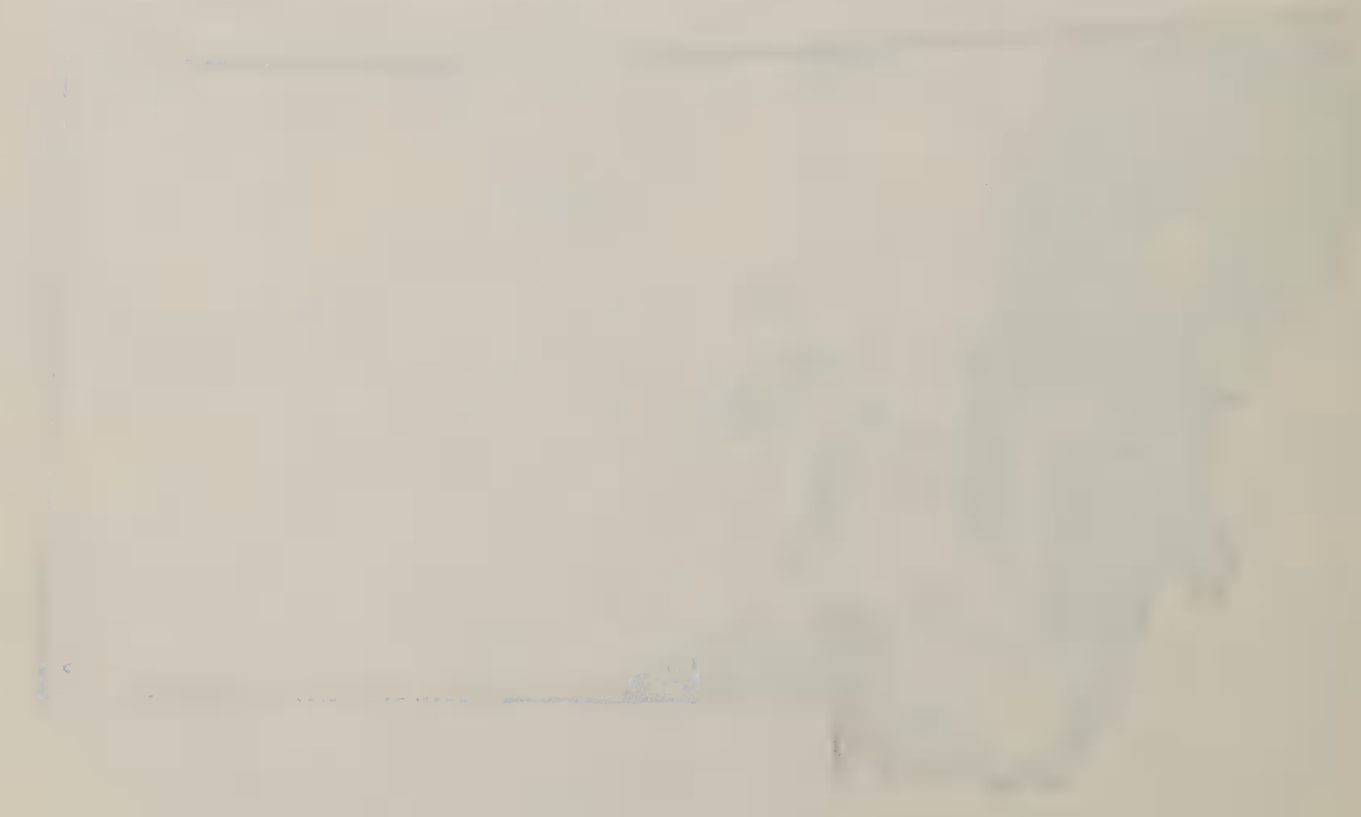
Areas of mountain pine beetle-infested lodgepole pine in Montana.

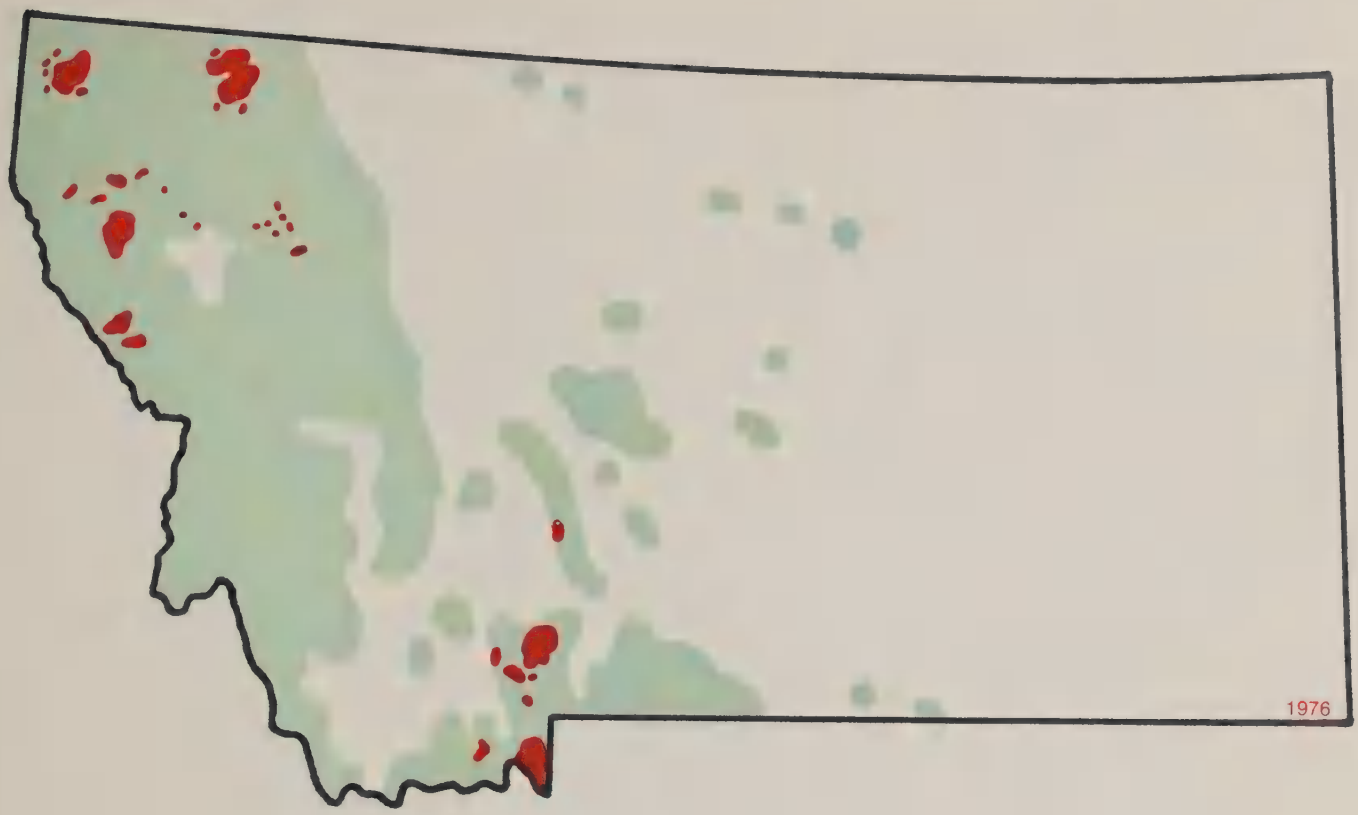


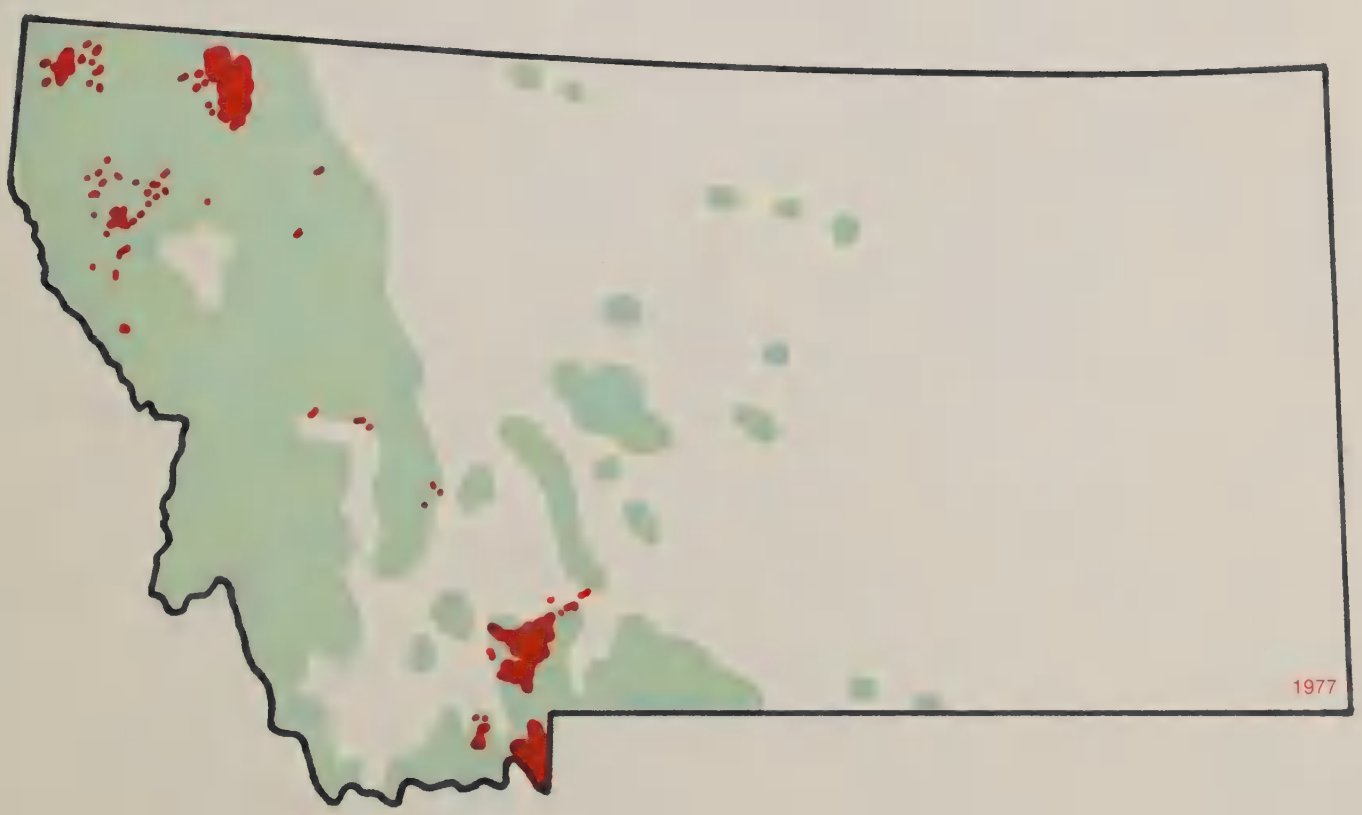


Areas of mountain pine beetle-infested lodgepole pine in Montana.

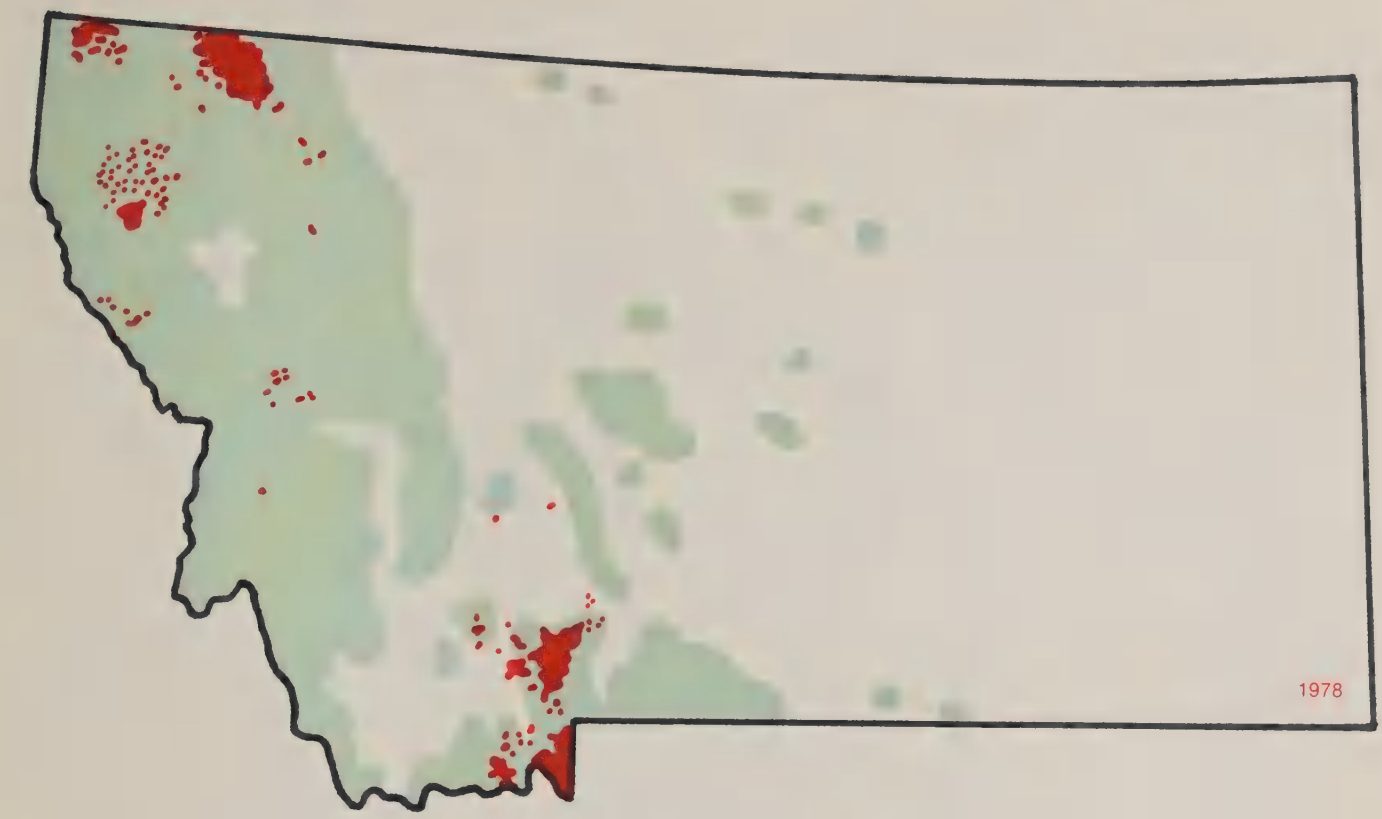




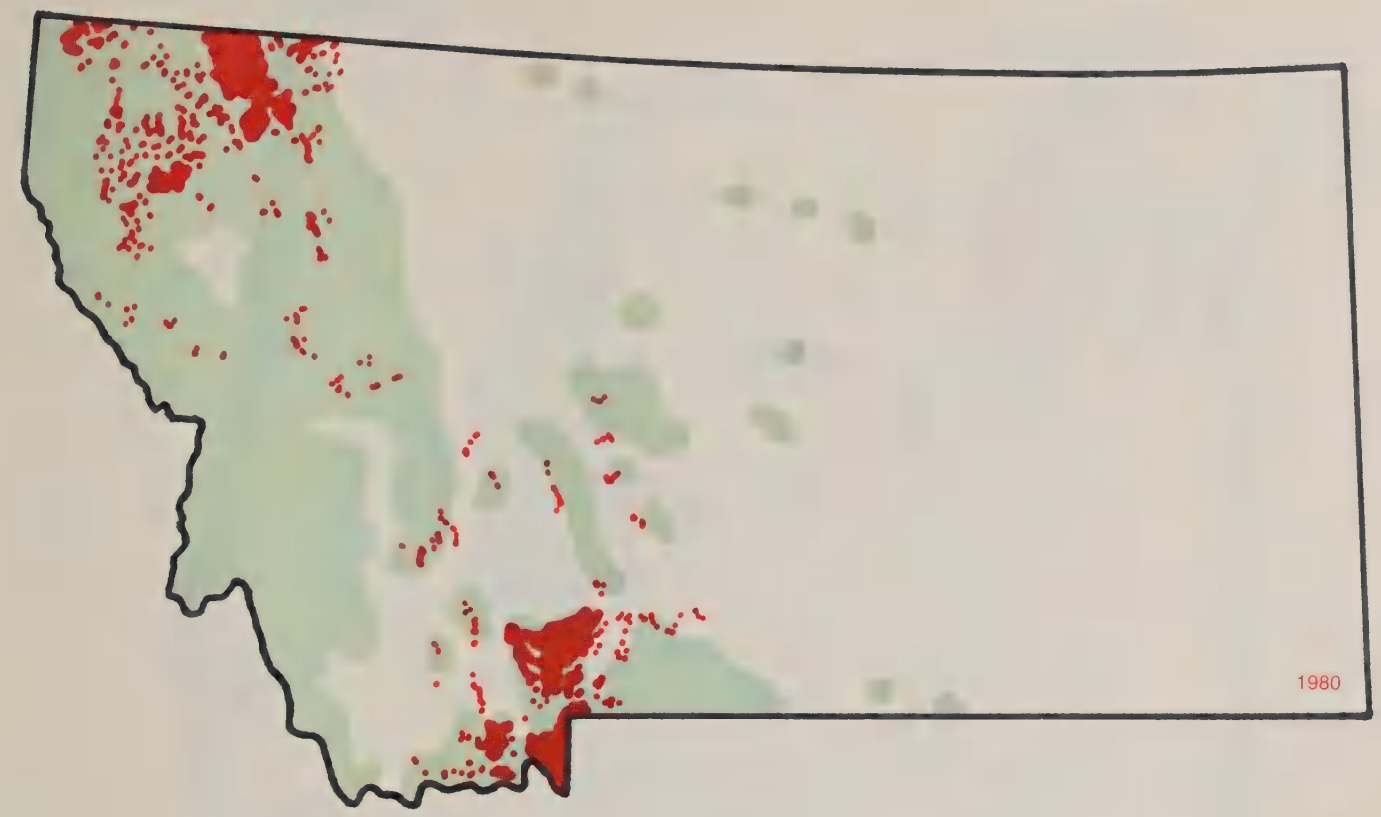




Areas of mountain pine beetle-infested lodgepole pine in Montana.

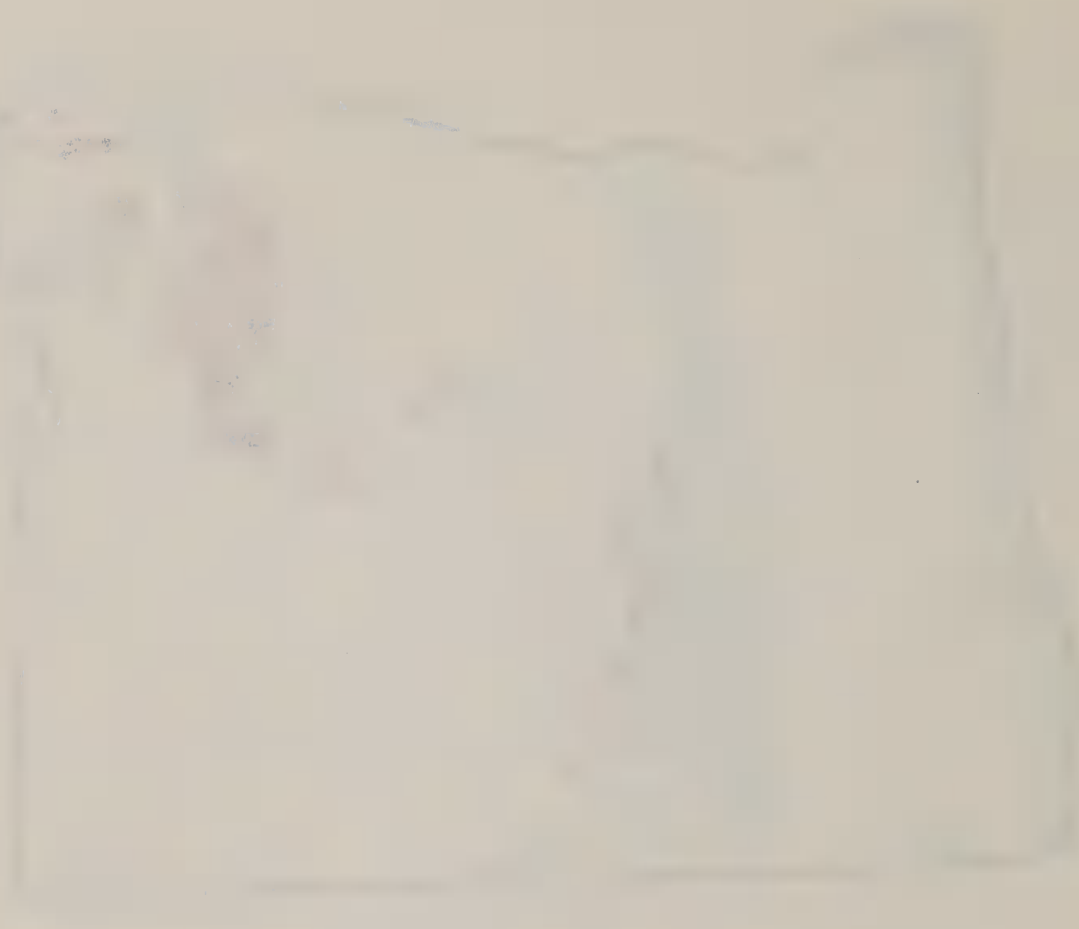


Areas of mountain pine beetle-infested lodgepole pine in Montana.

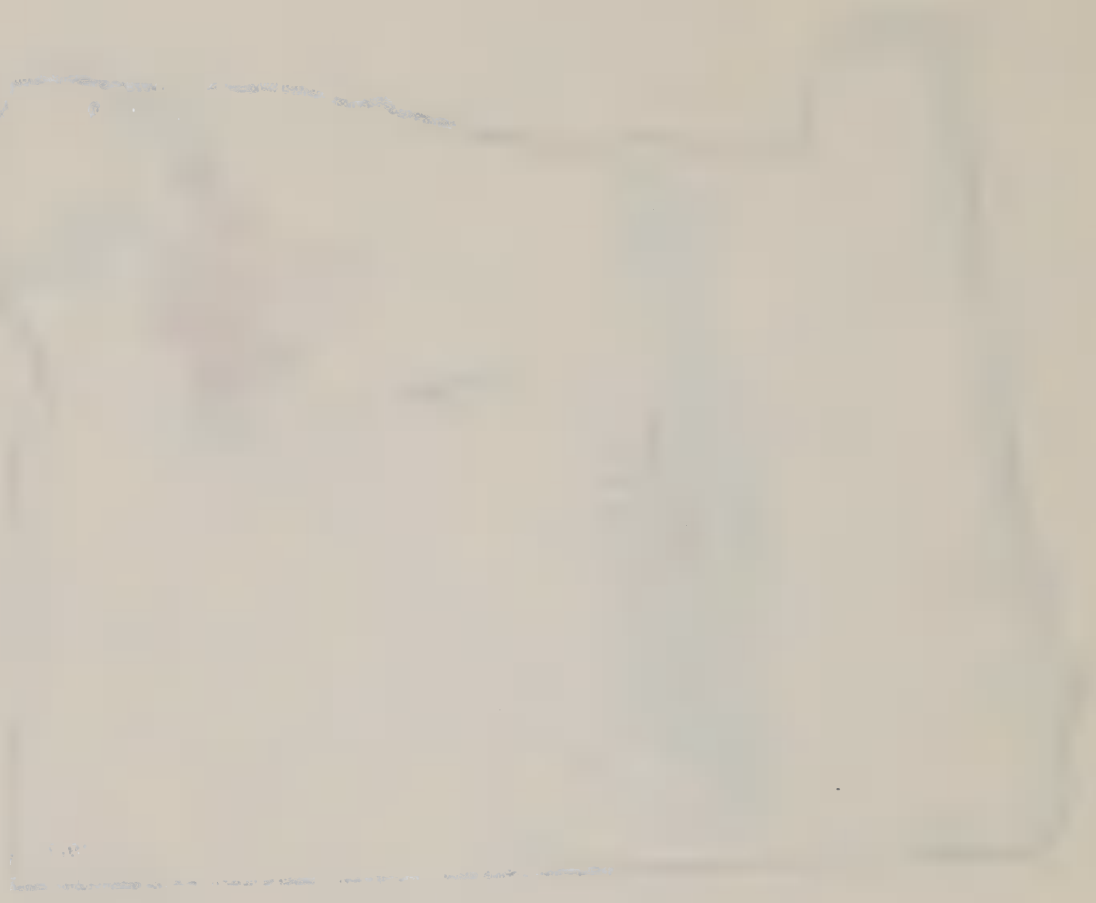


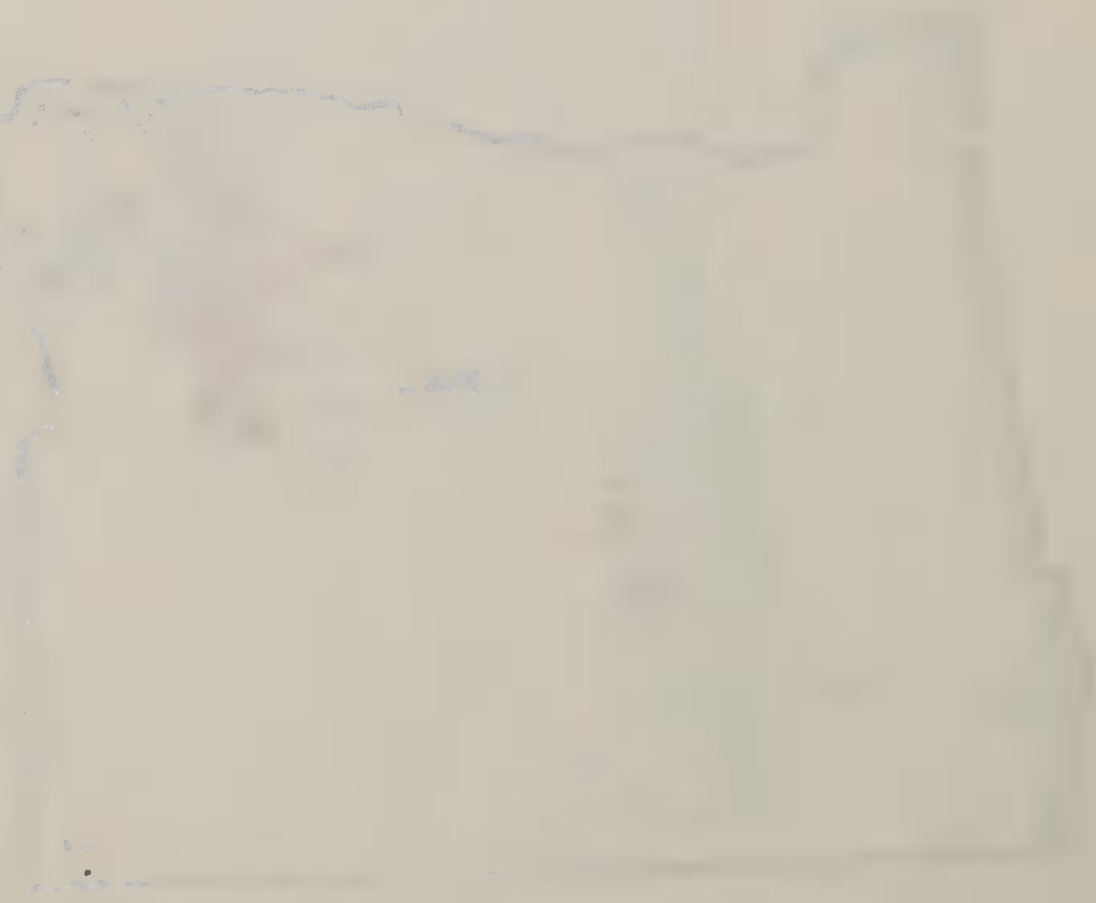
Areas of mountain pine beetle-infested lodgepole pine in Montana.

Areas of mountain pine beetle-infested lodgepole pine in Oregon.

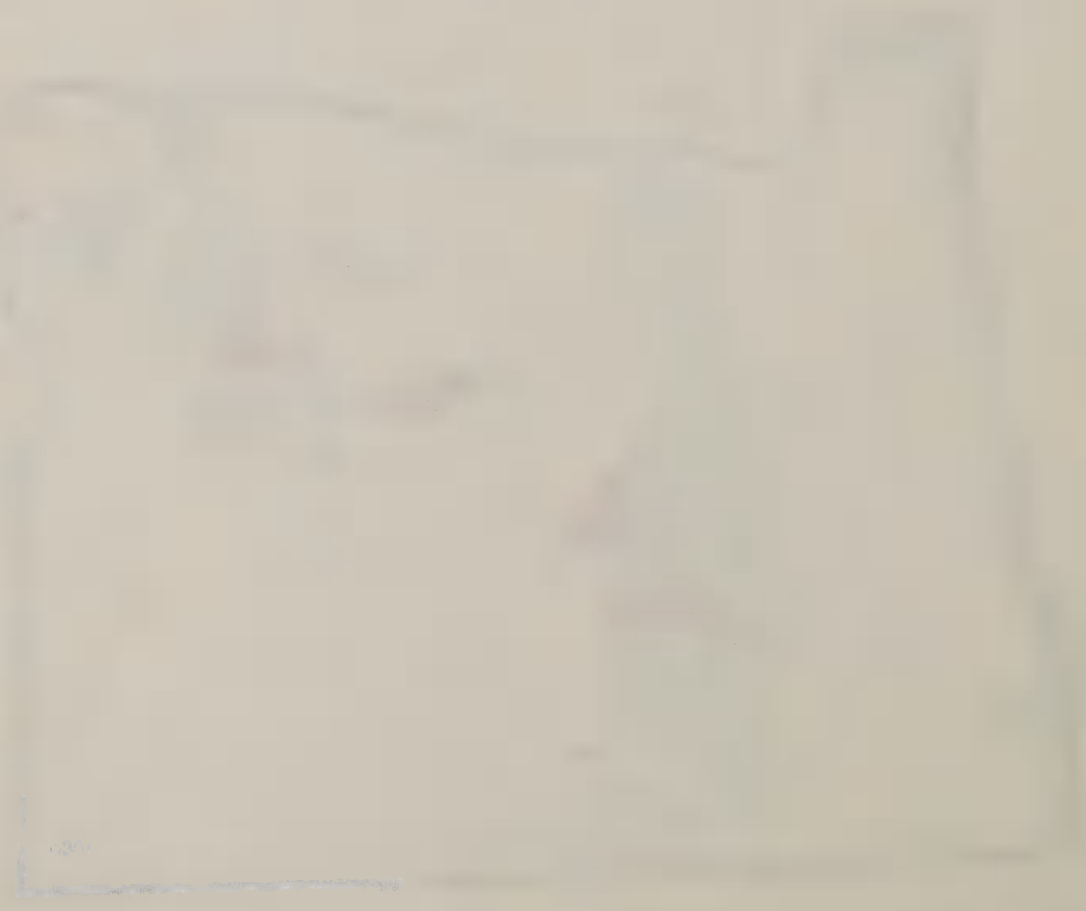


Areas of mountain pine beetle-infested lodgepole pine in Oregon.

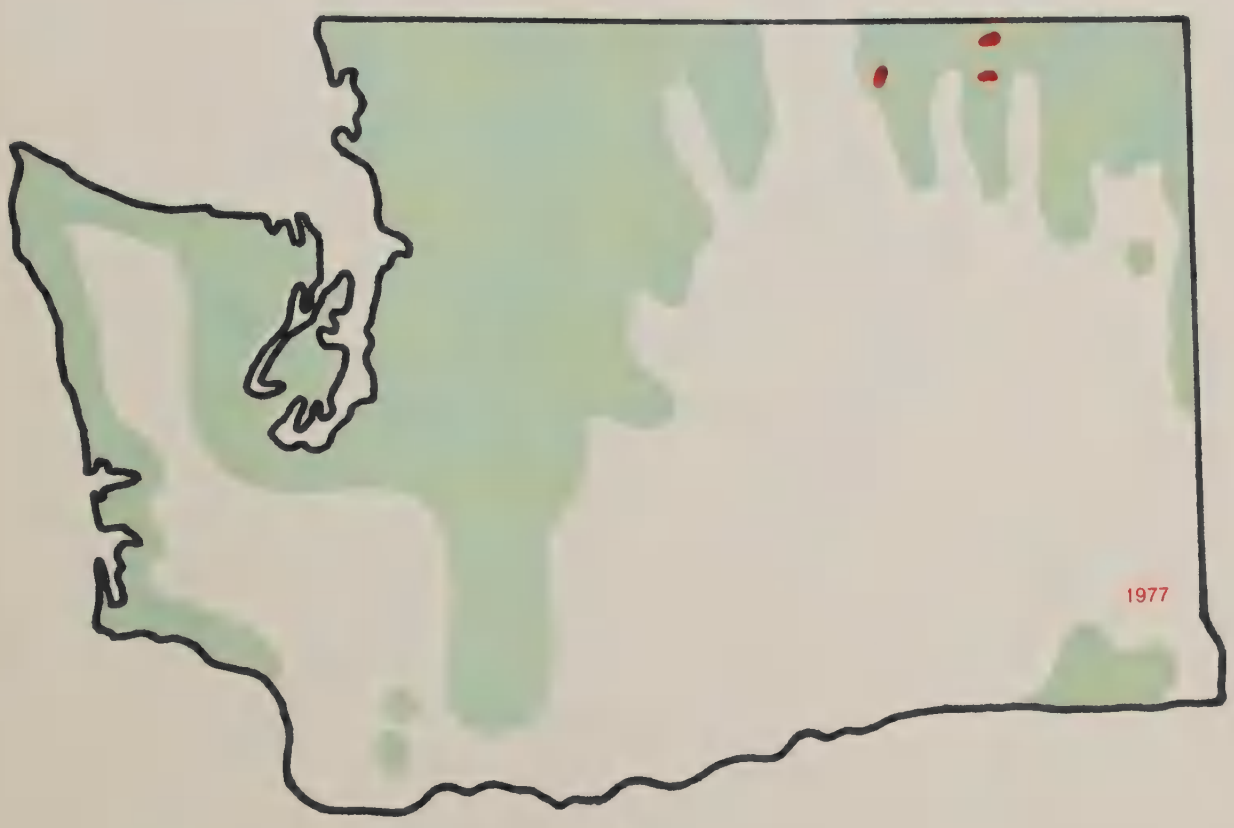




Areas of mountain pine beetle-infested lodgepole pine in Oregon.



Areas of mountain pine beetle-infested lodgepole pine in Oregon.



Areas of mountain pine beetle-infested lodgepole pine in Washington.

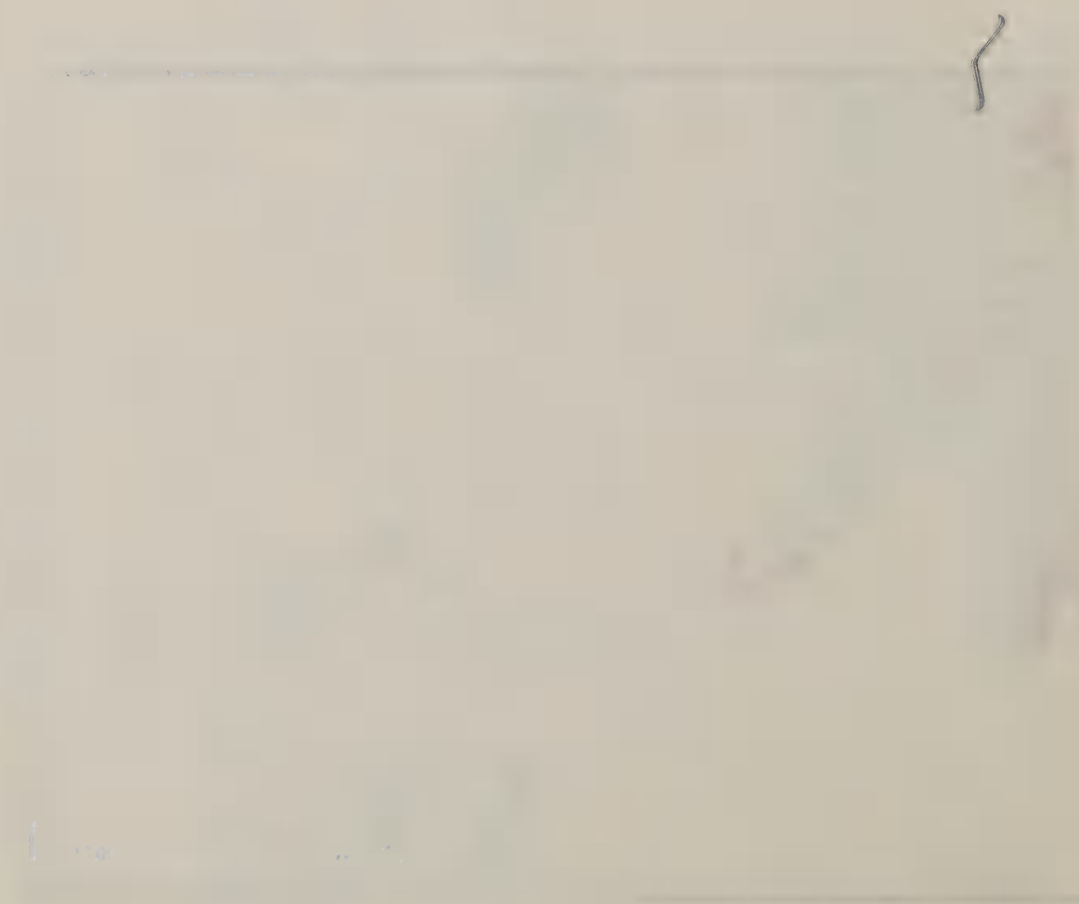
Areas of mountain pine beetle-infested lodgepole pine in Washington.

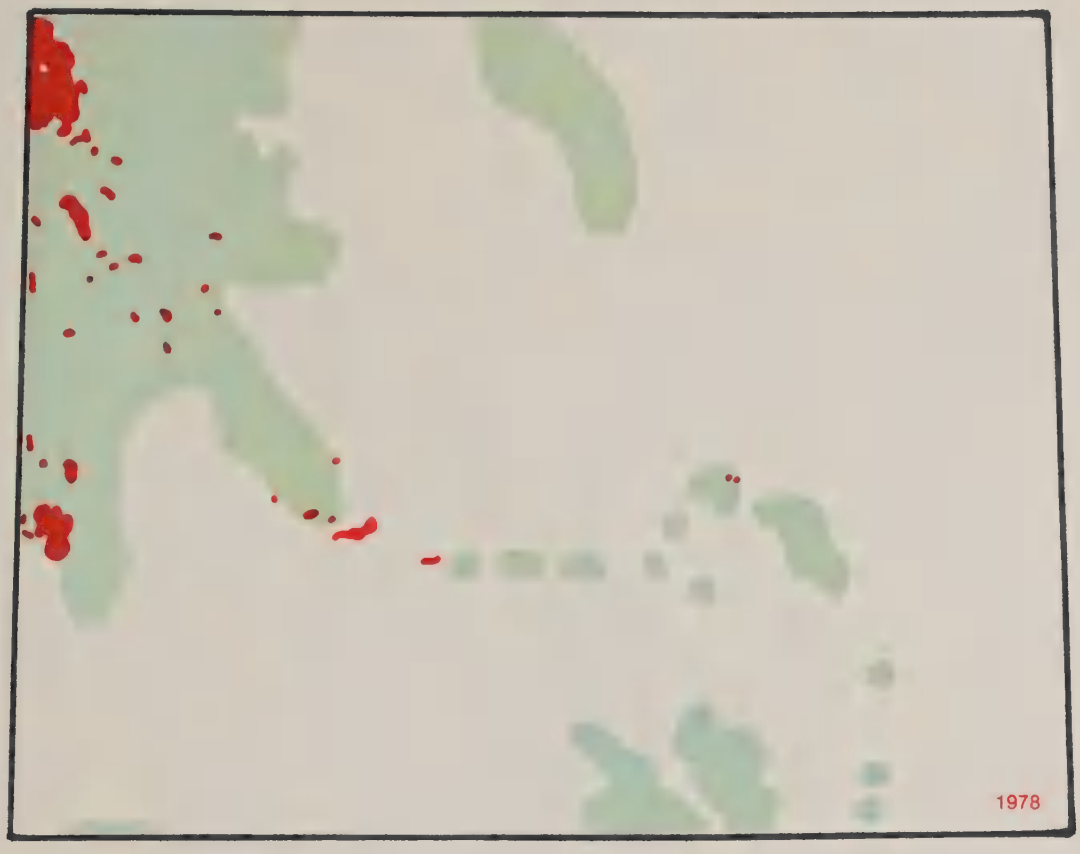
Areas of mountain pine beetle-infested lodgepole pine in Washington.

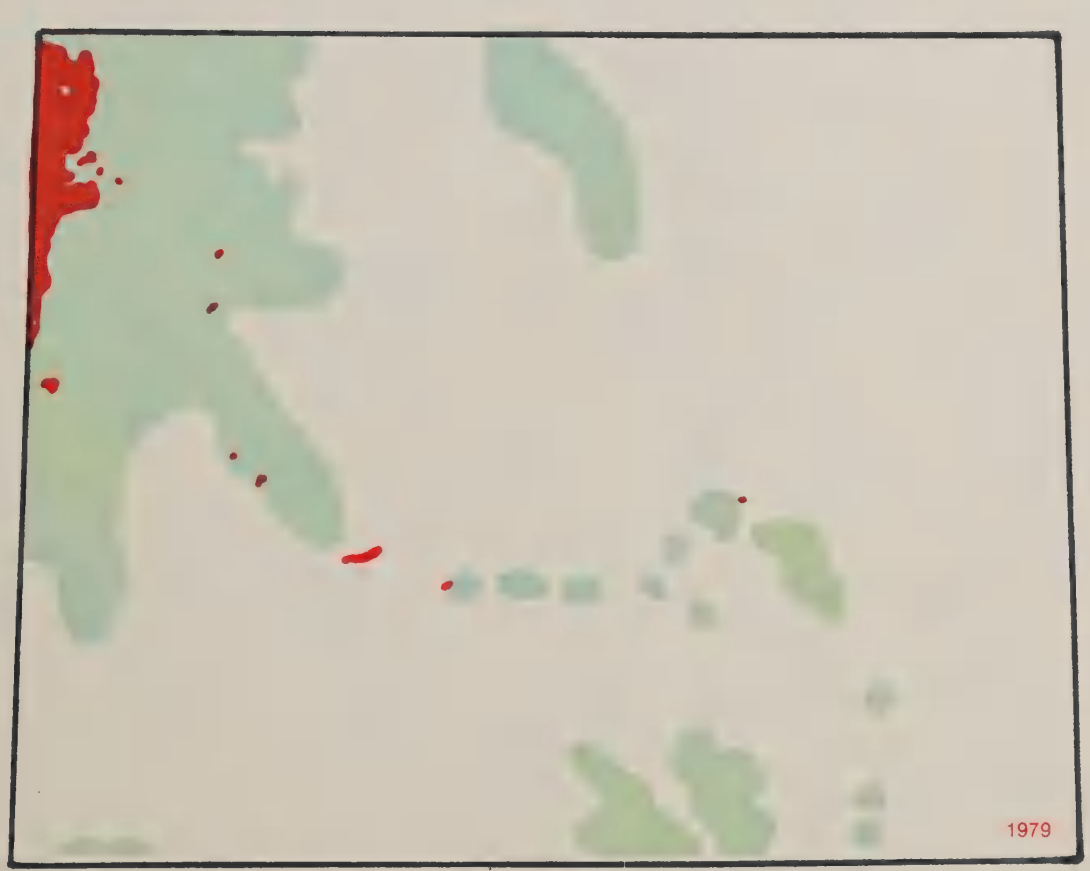
Areas of mountain pine beetle-infested lodgepole pine in Wyoming.

Areas of mountain pine beetle-infested lodgepole pine in Wyoming.

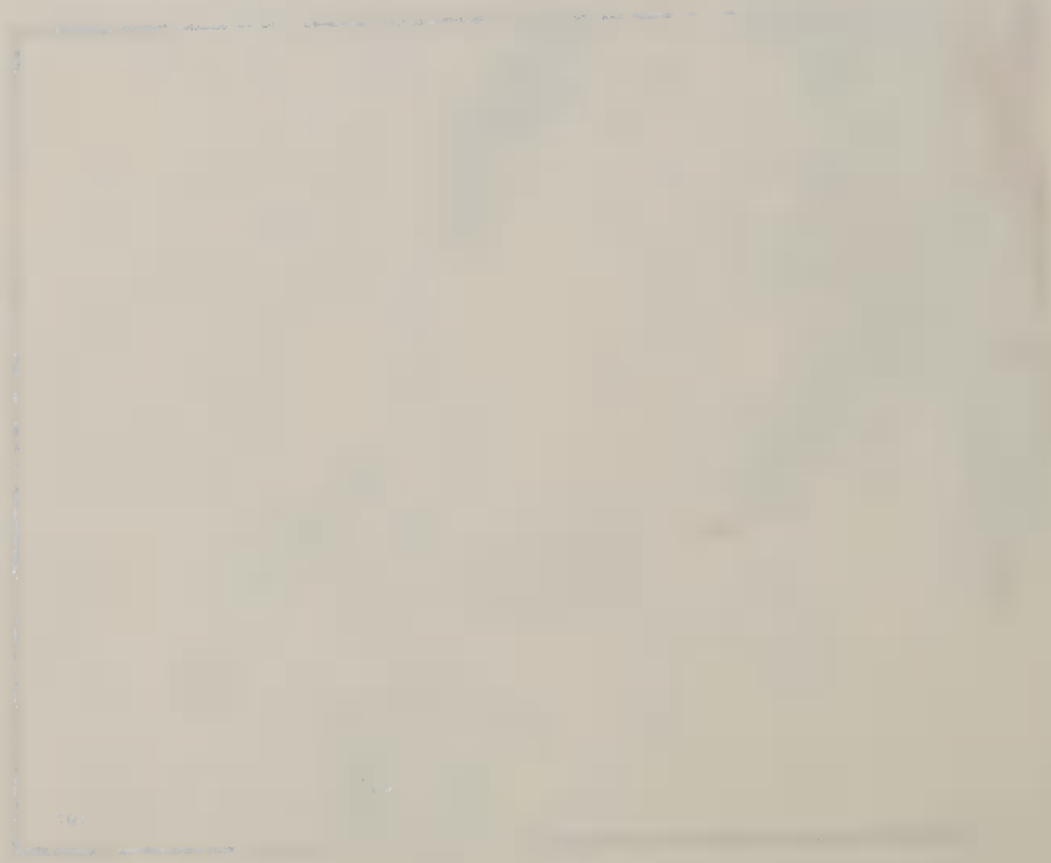
Areas of mountain pine beetle-infested lodgepole pine in Wyoming.





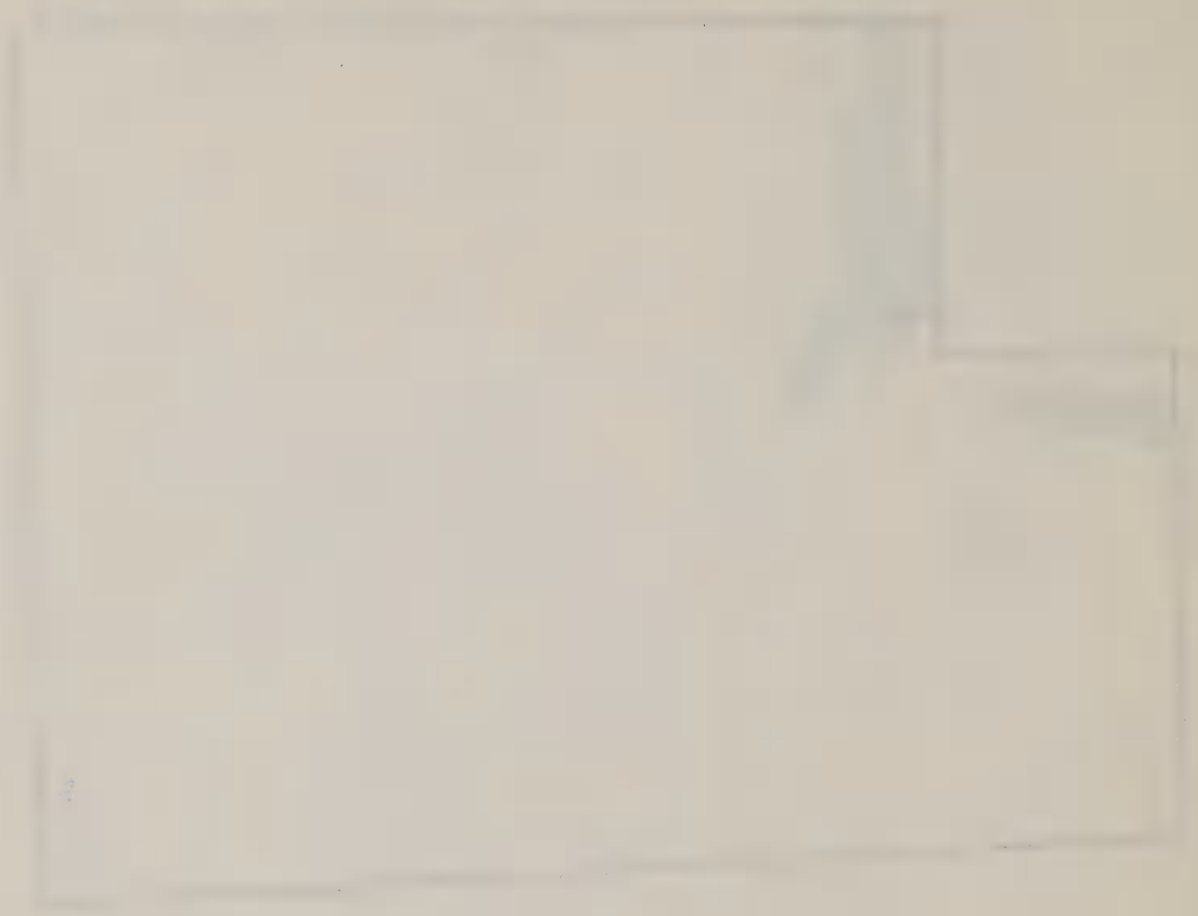


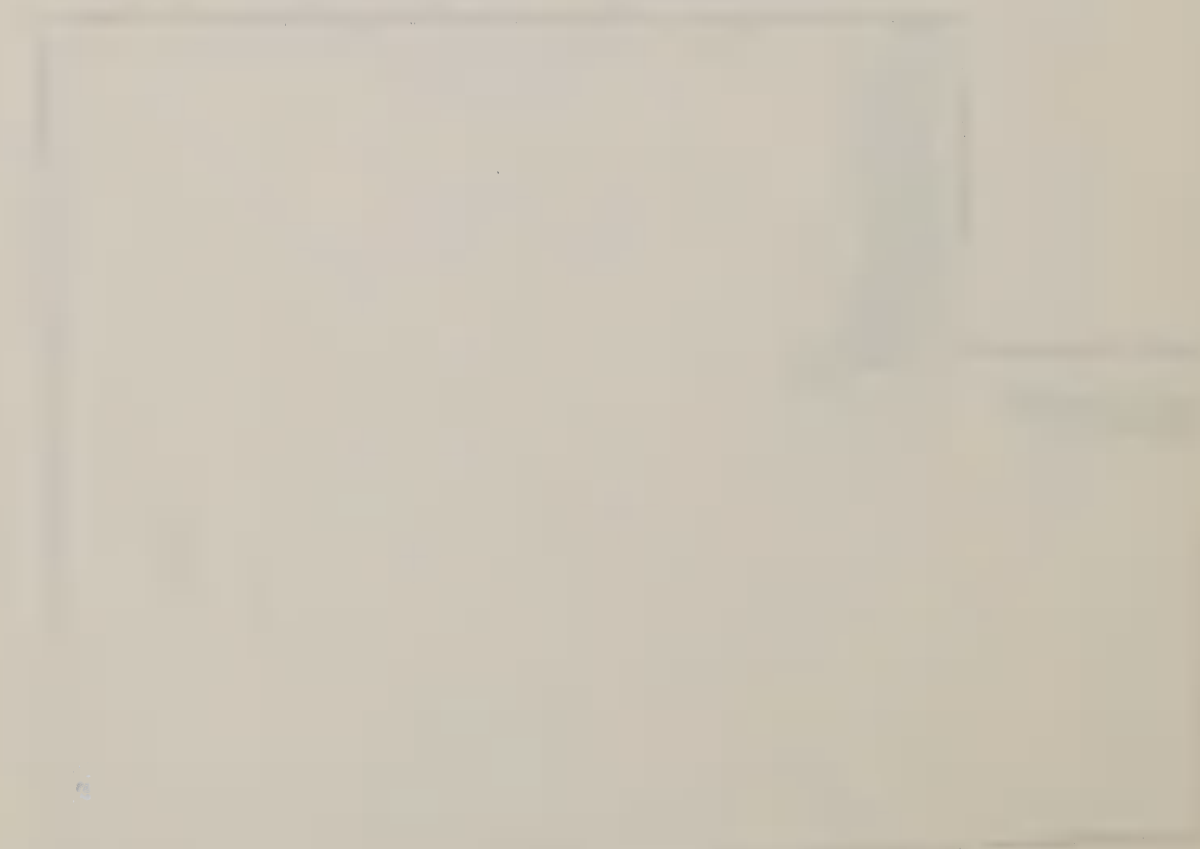
Areas of mountain pine beetle-infested lodgepole pine in Wyoming.

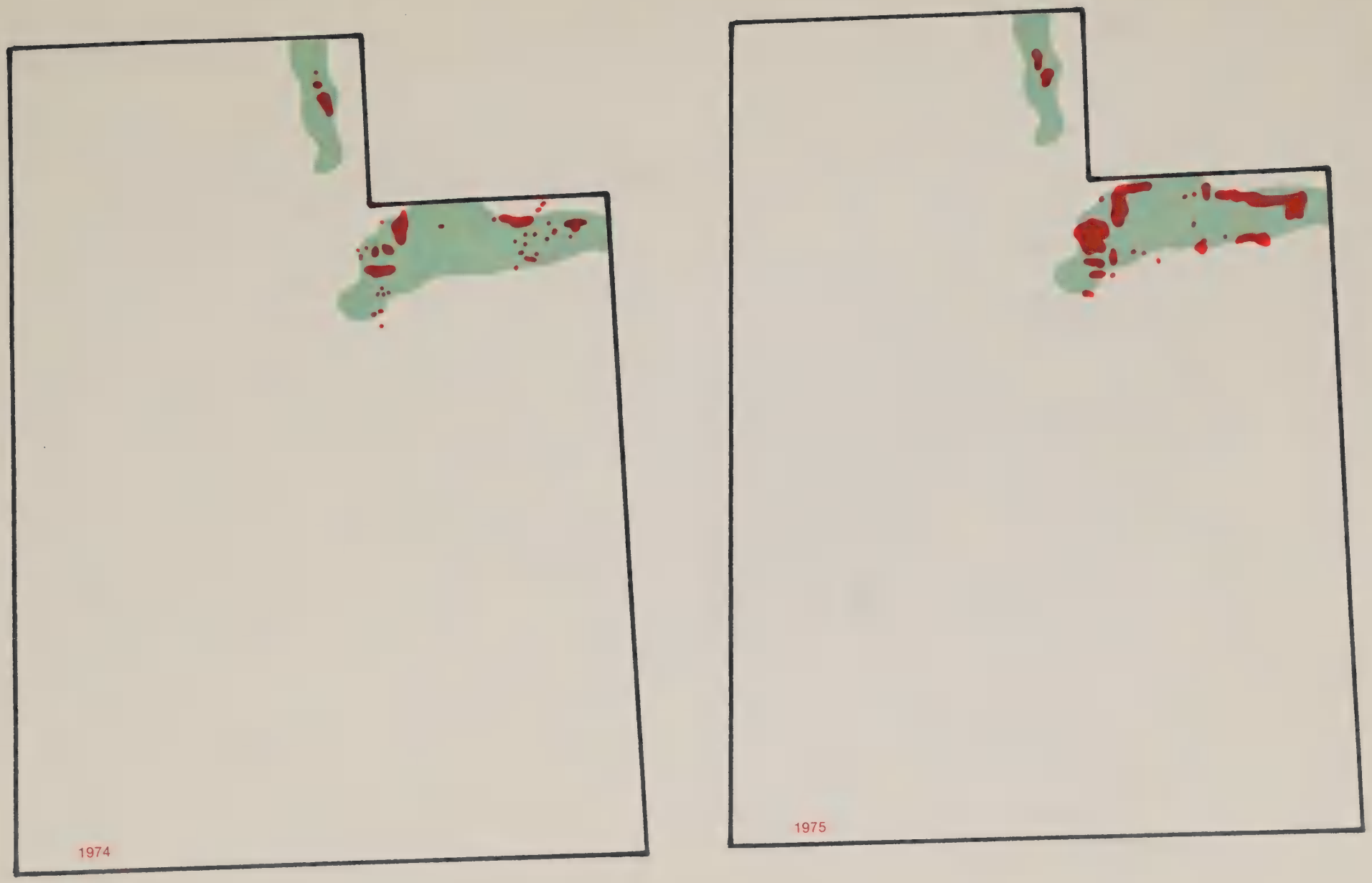


Areas of mountain pine beetle-infested lodgepole pine in Wyoming.

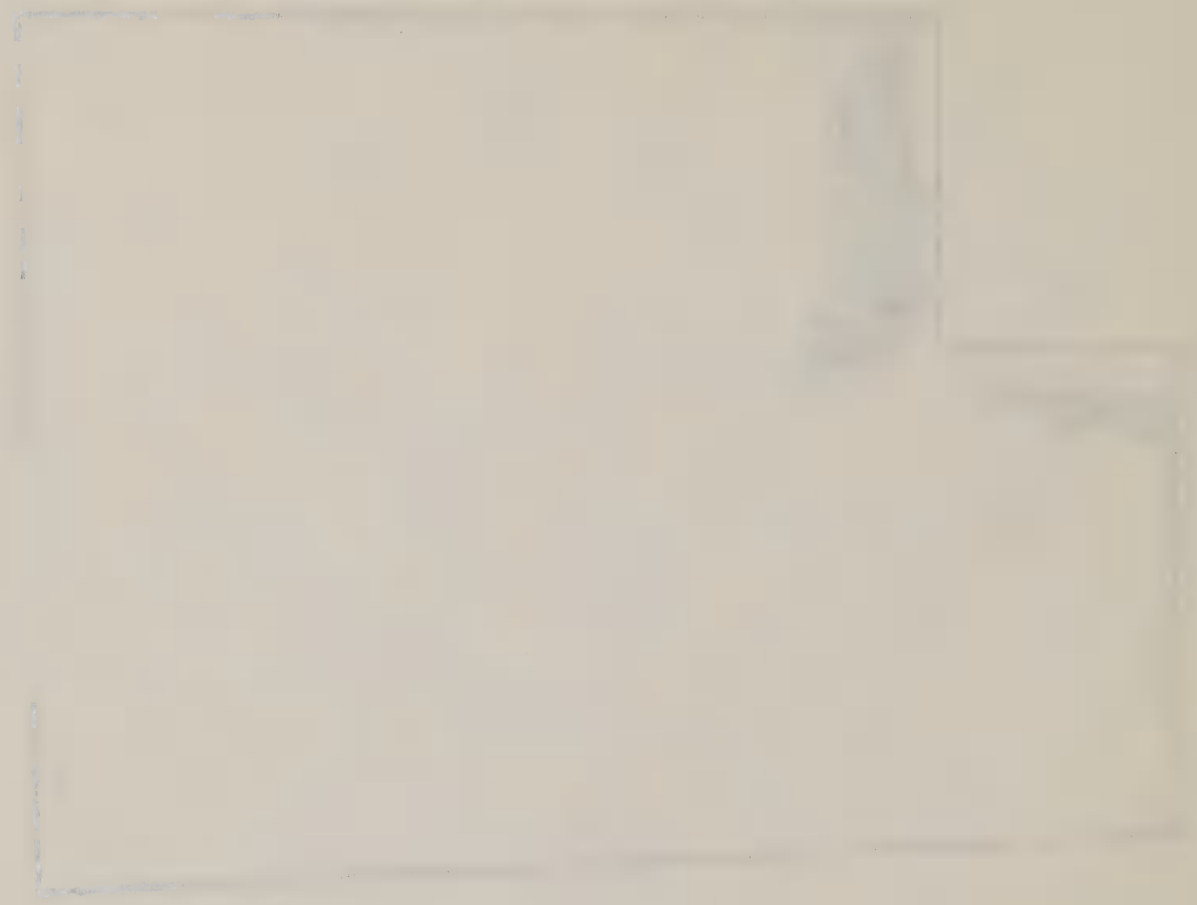
Areas of mountain pine beetle-infested lodgepole pine in Utah.

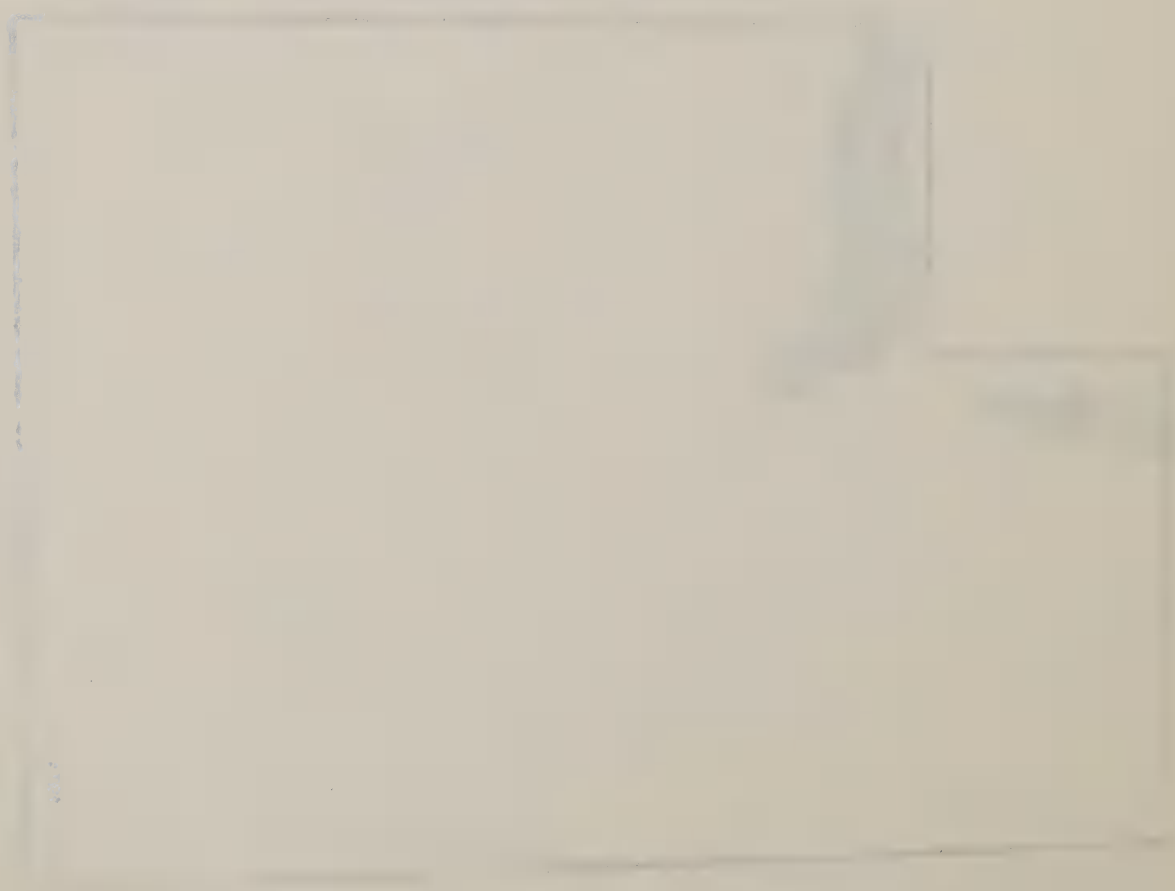




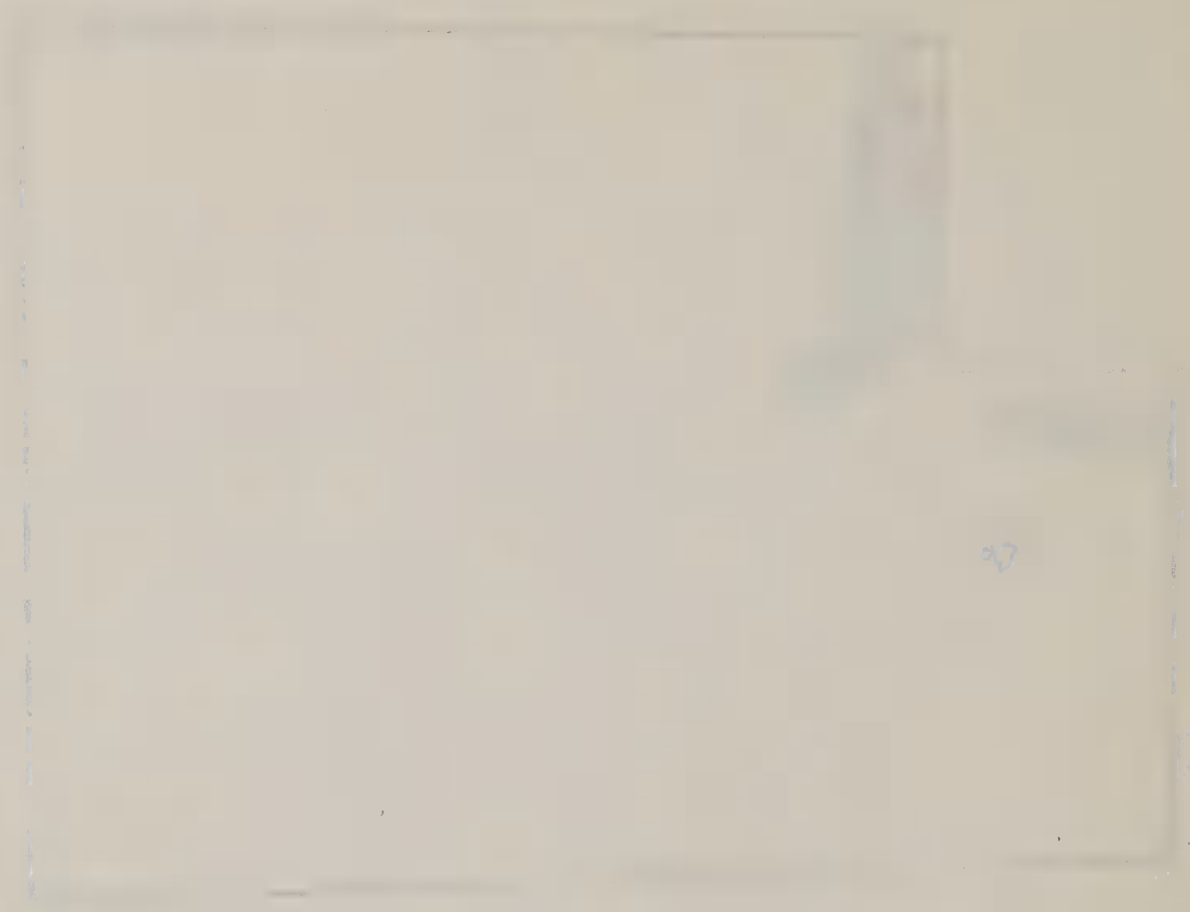


Areas of mountain pine beetle-infested lodgepole pine in Utah.

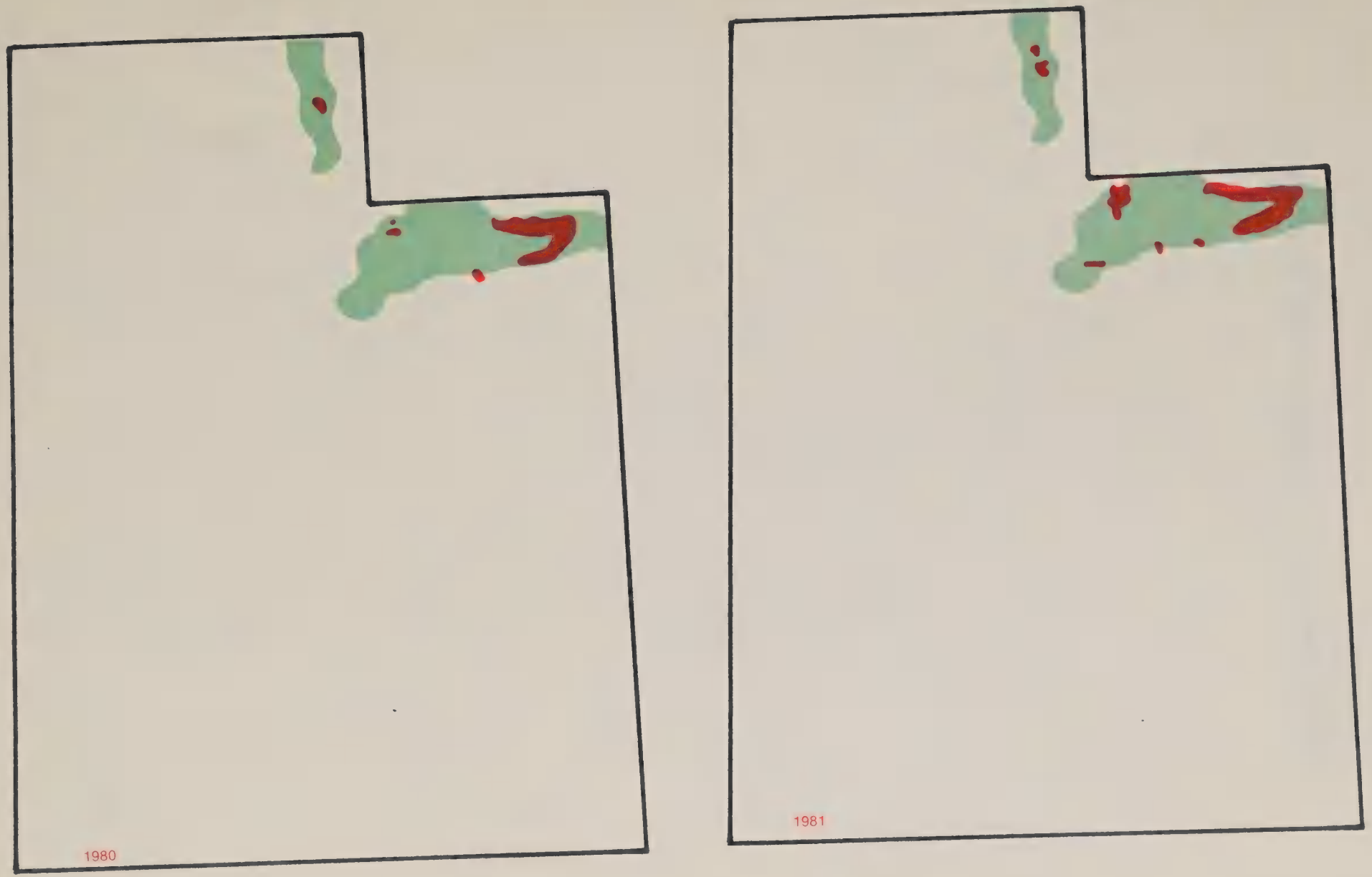




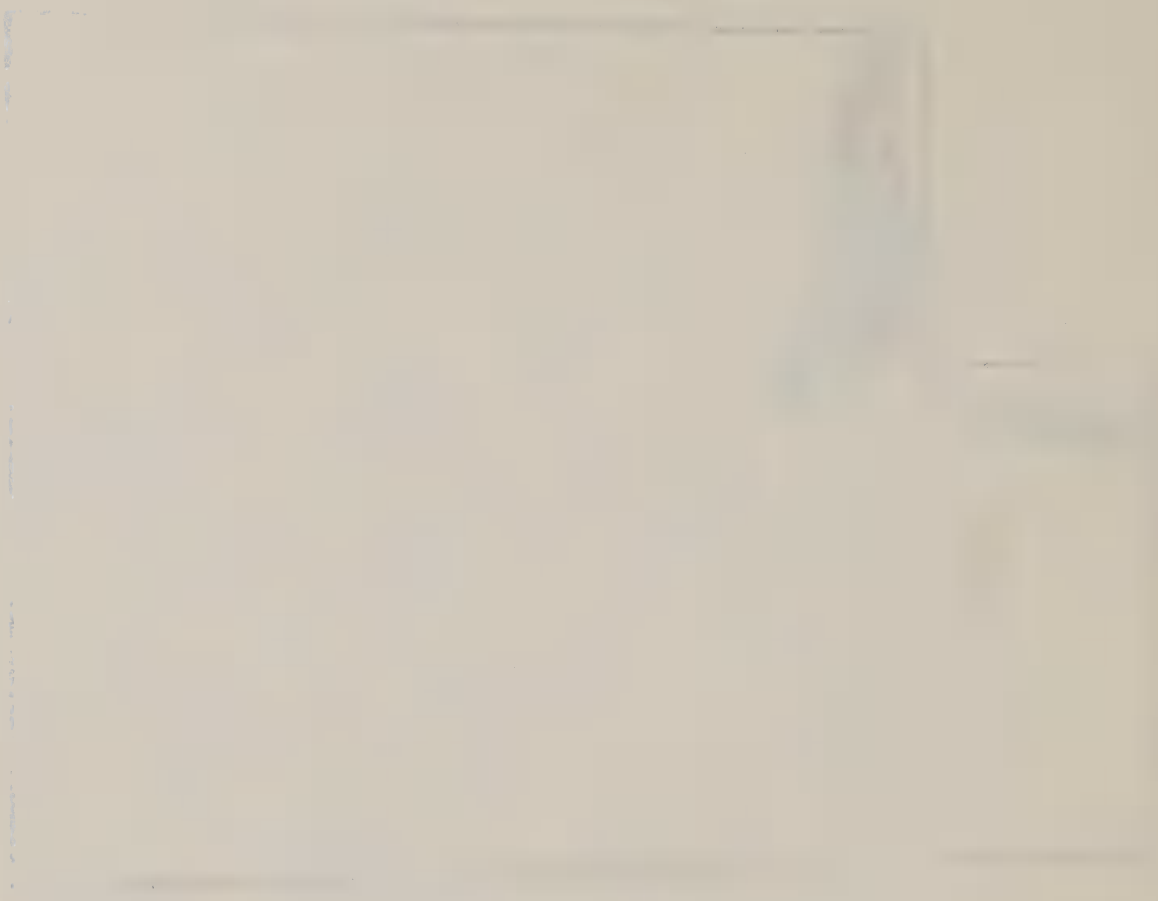
Areas of mountain pine beetle-infested lodgepole pine in Utah.

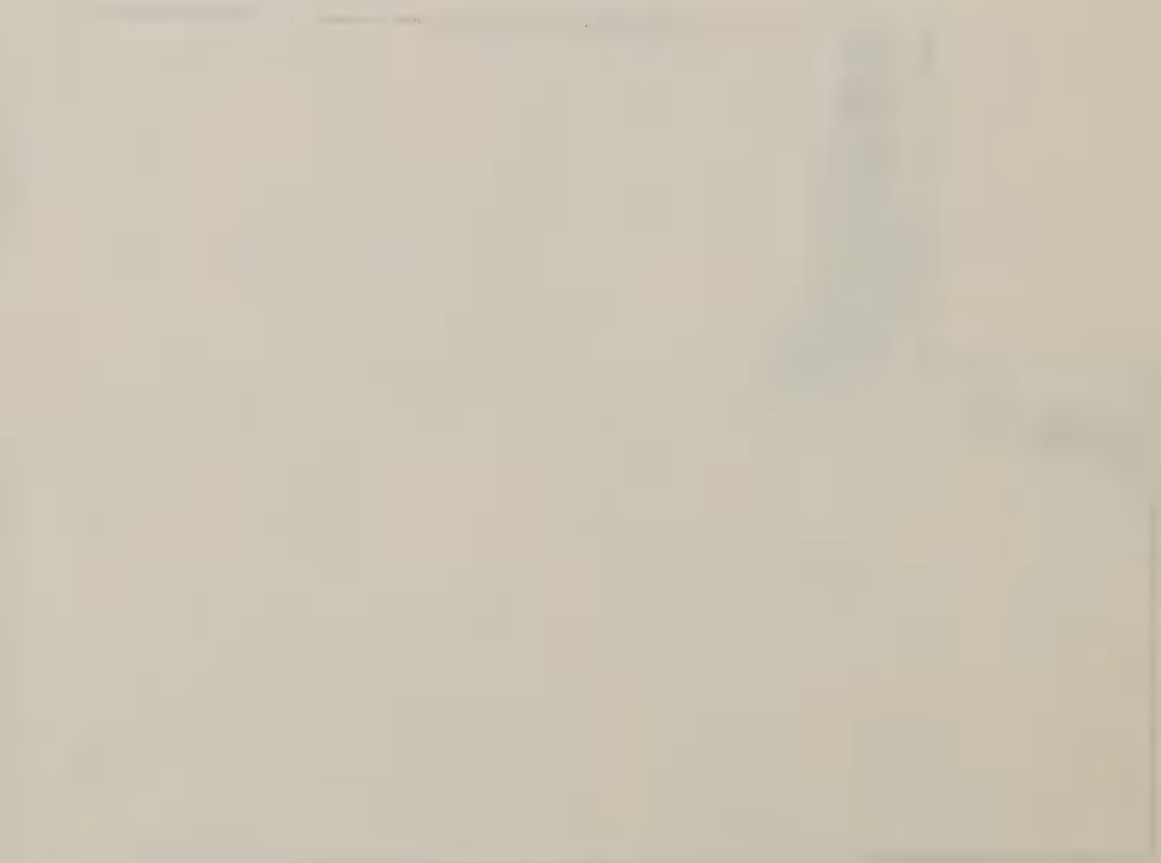


Areas of mountain pine beetle-infested lodgepole pine in Utah.



Areas of mountain pine beetle-infested lodgepole pine in Utah.





APPENDIX IV STATUS OF CANADA MOUNTAIN PINE BEETLE INFESTATIONS

APPENDIX V

ACRES INFESTED AND AMOUNT OF RECENT LODGEPOLE PINE MORTALITY WITH PROJECTIONS THROUGH 1985 FOR EACH PROVINCE IN CANADA

APPENDIX VI

CHRONOLOGICAL MAPS OF LODGEPOLE PINE AREAS AND MOUNTAIN PINE BEETLE INFESTATIONS IN CANADA

APPENDIX VII **ACTION PLAN**

Objective:

The following short- and long-term Canada/United States actions designed to reduce the magnitude of the lodgepole pine/mountain pine beetle problem have been agreed to. D. R. Macdonald, Canadian Forestry Service (CFS), Pacific Forest Research Centre, and D. A. Graham, USDA Forest Service (USFS), Washington Office, are responsible for the overall leadership, coordination, and followup needed to insure timely implementation of this Action Plan. Actual implementation of most of the identified tasks is completely dependent on the priorities placed on this work by the two governments and other agencies and organizations involved through the allocation of the necessary funds and resources to the responsible organizations and individuals.

I. Jointly develop organizational structure and plans necessary for accomplishing the objective.

   A. Develop and implement Memorandum of Understanding Supplement between Canada/United States on lodgepole pine management/mountain pine beetle. (D. GRAHAM, USFS, and D. R. MACDONALD, CFS)

      Responsible units: Canadian Forestry Service and USDA Forest Service.

      Accomplishment date: March 1, 1982.

NOTE: Where more than one person is assigned accomplishment responsibility, the individual who is listed first has the lead role in their respective countries.

In Canada: PFCR = Pacific Forest Research Centre; NFRC = Northern Forest Research Centre; BCFS = British Columbia Forest Service; and AFS = Alberta Forest Service.

In the United States: OSU = Oregon State University; INT = Intermountain Forest and Range Experiment Station, USFS; RM = Rocky Mountain Forest and Range Experiment Station, USFS; PNW = Pacific Northwest Forest and Range Experiment Station, USFS; R-1 = Northern Region, USFS; R-2 = Rocky Mountain Region, USFS; R-4 = Intermountain Region, USFS; R-6 = Pacific Northwest Region, USFS; MAG = Methods Application Group, USFS; and WO = Washington Office, USFS.

B. Provide for joint review and acceptance of lodgepole pine management/mountain pine beetle Action Plan. (D. GRAHAM, USFS, and D. R. MACDONALD, CFS)

Responsible units: Canadian Forestry Service and USDA Forest Service.

Accomplishment date: November 1, 1982.

C. Establish process to insure full documentation and dissemination of Action Plan findings, recommendations, and results, including interim progress reports as needed. (D. GRAHAM, USFS, WO; D. R. MACDONALD, CFS, PFRC; PROGRAM MANAGEMENT PROTECTION, CFS, PFRC).

Responsible units: Canadian Forestry Service Pacific Forest Research Center and USDA Forest Service, Washington Office.

Accomplishment date: November 1, 1982.

D. Establish process to fully document and disseminate information on methodology currently in use and that which will be developed, including research results and recommendations. (D. GRAHAM, WO; M. McGREGOR, R-1; R. NAUMAN, R-1; W. COLE, INT; LES SAFRANYIK, CFS, PFRC; PETER HALL, BCFS; BOB MIYAGAWA, AFS)

Responsible units: Canadian Forestry Service Pacific Forest Research Center; British Columbia Forest Service; Alberta Forest Service; and USDA Forest Service, Washington Office, Northern Region, Intermountain Forest and Range Experiment Station.

Accomplishment date: November 1, 1983, and continuing as necessary.

E. Schedule joint planning sessions to develop detailed work plans needed to attain the goals of the five general study areas presented in the mountain pine beetle supplement memorandum of understanding. (D. GRAHAM and M. McFADDEN, WO; PROGRAM PROTECTION MANAGER, CFS, PFRC; BOB DUBOO, BCFS)

1. Integration into management.

2. Improved utilization.

3. Loss reduction.

4. Accelerated thinning and harvesting.

5. Information exchange.

Responsible units: Canadian Forestry Service Pacific Forest Research Center; British Columbia Forest Service; and USDA Forest Service, Washington Office.

Accomplishment date: November 1, 1983.

F. Determine what type of action both countries are willing to take in areas where timber production is not the primary management objective. (D. GRAHAM, WO; REPRESENTATIVE FROM BCFS; REPRESENTATIVE FROM AFS; AD KIIL, CFS, NFRC)

Responsible units: Canadian Forestry Service Northern Forest Research Center; British Columbia Forest Service; Alberta Forest Service; and USDA Forest Service, Washington Office.

Accomplishment date: March 1, 1983.

II. Jointly determine which impact reduction strategies are currently available for practical operational application and implementation.

A. Update existing management guidelines, determine applicability of harvest strategies, and synthesize existing knowledge for specific situations. (M. McGREGOR, R-1; G. AMMAN, INT; K. LISTER, R-2; D. HOLLAND, R-4; R. DOLPH, R-6; HERB CEREZKE, CFS, NFRC; PETER HALL, BCFS; MALCOLM SHIMPTON, CFS, PFRC; BOB MIYAGAWA, AFS)

Responsible units: Canadian Forestry Service Pacific Forest Research and Northern Forest Research Centers; British Columbia Forestry Service; Alberta Forestry Service; and USDA Forest Service, Northern, Rocky Mountain, Intermountain and Pacific Northwest Regions, and Intermountain Forest and Range Experiment Station.

Accomplishment date: March 1, 1983.

B. Establish mechanism for close coordination of lodgepole pine management in stands adjacent to Canada/U.S. border. (J. BENNETT, R-1; J. USHER, R-6; REPRESENTATIVE FROM BCFS; BOB MIYAGAWA, AFS; AL VAN SICKLE, CFS, PFRC)

1. Exchange inventory information.

2. Exchange survey and biological data.

3. Jointly plan and develop access roads.

Responsible units: Canadian Forestry Service Pacific Forest Research Center; British Columbia Forestry Service; Alberta Forestry Service; and USDA Forest Service, Kootenai, Flathead, Idaho Panhandle Colville, and Okanogan National Forests.

First status report due: July 1, 1983.

C. Assess the mountain pine beetle social and economic impacts. (W. CIESLA, MAG; R. BARGER, INT; G. MANNING, CFS, PFRC)

Responsible units: Canadian Forestry Service Pacific Forest Research Center; and USDA Forest Service, Methods Application Group and Economics Research, Intermountain Forest and Range Experiment Station.

Accomplishment date: December 31, 1982.

D. Establish mechanism for joint use and development of "demonstration areas" and for rapid exchange of technology. (M. McGREGOR, R-1; K. LISTER, R-2; D. HOLLAND, R-4; R. DOLPH, R-6; W. COLE, INT; R. MITHCELL, PNW; R. STEVENS, RM; G. PITMAN, OSU; PETER HALL, BCFS; BOB MIYAGAWA, AFS; LES SAFRANYIK, CFS, PFRC; HERB CEREZKE, CFS, NFRC)

Responsible units: Canadian Forestry Service Pacific and Northern Forest Research Centers; British Columbia Forest Service; Alberta Forest Service; USDA Forest Service, Northern, Rocky Mountain, Intermountain, and Pacific Northwest Regions, Intermountain, Pacific Northwest, and Rocky Mountain Forest and Range Experiment Stations; and Oregon State University.

Accomplishment date: December 31, 1982.

III. Jointly develop, improve, and/or refine methods and systems to enhance the management and harvesting of lodgepole pine subjected to the mountain pine beetle.

A. Develop and evaluate the long-term effects of silvicultural practices on lodgepole pine management strategies for converting unmanaged stands to managed stands. (M. COLE, INT; M. McGREGOR and R. JOHNSON, R-1; R. STEVENS, RM; LES SAFRANYIK, CFS, PFRC; JIM GILLMOUR, BCFS; LOREN BRACE, CFS, NFRC)

Responsible units: Canadian Forestry Service Pacific and Northern Forest Research Centers; and USDA Forest Service, Intermountain and Rocky Mountain Forest and Range Experiment Stations, and Northern Region.

First status report due: November 1, 1983.

B. Identify factors influencing outbreaks in managed lodgepole pine stands. Evaluate mountain pine beetle susceptibility, stand development, and resource production. (R. SCHMITZ, INT; R. MITCHELL, PNW; MALCOLM SHRIMPTON, CFS, PFRC)

Responsible units: Canadian Forestry Service Pacific Forest Research Center; and USDA Forest Service, Intermountain and Pacific Northwest Forest and Range Experiment Stations.

First status report due: November 1, 1984.

C. Determine the most appropriate lodgepole pine hazard rating system for various geographical areas. (G. AMMAN, INT; M. McGREGOR, R-1; R. DOLPH, R-6; R. MITCHELL, PNW; G. PITMAN, OSU; LES SAFRANYIK, MALCOLM SHRIMPTON, and STU WHITNEY, CFS, PFRC; PETER HALL and INVENTORY REPRESENTATIVE, BCFS)

Responsible units: Canadian Forestry Service Pacific Forest Research Center; British Columbia Forest Service; and USDA Forest Service, Northern, Pacific Northwest Regions, and Intermountain and Pacific Northwest Forest and Range Experiment Stations; and Oregon State University.

First status report due: March 1, 1983.

D. Evaluate and identify (including harvesting) opportunities for marketing and improving the utilization of small diameter lodgepole pine. (R. BARGER, INT; REPRESENTATIVE FROM CFS; REPRESENTATIVE FROM FORINTEK CANADA CORPORATION)

Responsible units: Forintek Canada Corporation and USDA Forest Service, Intermountain Forest and Range Experiment Station.

Accomplishment date: July 1, 1983.

E. Develop improved processing (manufacturing) systems for lodgepole pine. (P. KOCH and M. GONSIOR, INT)

Responsible units: USDA Forest Service, Intermountain Forest and Range Experiment Station.

Accomplishment date: November 1, 1985.